ORACLE UNIVERSITY

Integrated Cloud Applications & Platform Services

Oracle Solaris 11 Advanced System Administration

Activity Guide

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Chapter 1

Practices for Lesson 1: Overview

Practices Overview

This practice introduces you to the project assignment, which you will be using throughout this course, and to your lab environment. The project assignment is divided into multiple phases, which are presented in the checklist in the section titled "Project Assignment." The checklist items are synchronized with the lesson topics.

Project Assignment

Your organization, Delicious Treats Company, is in the business of selling chocolate products online locally and globally. In the United States, the company's order, product, and customer information is stored on 350 servers that are strategically located in various states. Out of these 350 servers, 250 are Oracle Solaris x86/64 machines—for instance, Ultra 20s. Currently, the Oracle Solaris servers are running Oracle Solaris 10 or Solaris 9. According to the service-level agreements (SLAs), the business applications on these servers must be up 98% of the time.

The company learned that Oracle has launched Oracle Solaris 11, which contains many resource-saving features. The company is convinced that it can use Oracle Solaris 11.3 to its benefit. Therefore, it has issued the directive to upgrade all Oracle Solaris machines to Oracle Solaris 11.3.

As part of the Server Implementation team, you will install and configure Solaris 11.3. This will help you to explore Oracle Solaris 11.3 and prepare you to administer business applications and the operating system. Your senior system administrator has developed a predeployment test plan that consists of a checklist of tasks to be performed. (See the following table.) As you progress through each lesson in the course, you will implement the assigned tasks and report the results to your senior system administrator.

✓	**Oracle Solaris 11 Predeployment Checklist**
	Managing Services and Service Properties Using SMF
	Managing Software Packages by Using IPS
	Managing Data Backup and Restore by Using ZFS
	Configuring the Network
	Administering Network Services
	Advanced Administration of Zones
	Securing the Oracle Solaris 11 OS
	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practices Infrastructure

This section presents an architectural view of the equipment and platforms for the practices. In these practices, you become familiar with the Oracle VM Server environment installed on your system. You log on to your system and connect to the virtual machines used for the hands-on practices. The following is a description of the practice environment:

- The practice environment is based on Oracle VM Server for x86, version 3.2.1.
- The environment consists of multiple virtual machines (VMs), which are configured on a private internal network (`192.168.1`). The VMs can communicate with each other over this private network.
- The GNOME desktop is installed on **dom0**.

The environment consists of the following VMs:

Name of the VM	Description
S11-Server1	This VM is installed with Oracle Solaris 11.3 Text Installer for x86. It provides NFS and DNS services. It should always be up and running. You use the command-line tools here. This VM provides the following: • Local IPS repository • DNS server • DHCP server • LDAP server • NFS server
S11-Desktop	This is installed with Oracle Solaris 11.3 Live Media installer for x86 and used as the IPS client machine. You will mostly use this to perform all the practices on this machine.
S11-Client1	This is used as the AI network client machine.
S11-Client2	This is used as the AI network client machine.
S11-Client3	This is used as the AI network client machine.
S11-Client4	This is used as the AI network client machine.

Note: After performing practice on **S11-Client1**, **S11-Client2**, **S11-Client3**, and **S11-Client4** machines, switch off the VMs. It will not be needed for any other practice.

The VMs are further configured to communicate with the host machine through the shared directory. The shared directories are as listed in the following table:

Resource Name	Location	Description
Host share directory	`/opt/ora`	Contains various course files
Demo files	`/opt/ora/demo`	Contains the demonstration file used in the course
OVA files	`/opt/ora/images`	Contains a backup of all virtual machines used in the course If any virtual machine gets corrupted while performing a practice, you can delete the virtual machine and import the respective VM from this folder. However, after reimporting, you will have to redo the previous practices to bring the VM to the required start state of the practice where the VM got corrupted.
ISO files	`/opt/ora/iso`	Contains the S11.3 GA ISO files required to perform practices
Lab files	`/opt/ora/labs`	Contains lab files
Scripts	`/opt/ora/scripts`	Contains scripts that are required to perform certain practices

The user credentials to be entered when accessing the VMs are listed in the following table:

VMs	Credentials
S11-Server1	• Username: `oracle` • Password: `oracle1` **Note:** As the `oracle` user, use `su` to switch to the primary administrator (`root`) role. The password is `oracle1`. `root` is configured as a role by default in Oracle Solaris 11. The first username created on the system during the installation is the initial privileged user who can assume the primary administrator role.
S11-Desktop	• Username: `oracle` • Password: `oracle1` **Note:** The `root` role password is `oracle1`.

Note: The responses to the commands shown in these practices are examples only. The values you see during your practices might vary slightly.

Practice 1-1: Exploring the dom0 Environment

Overview

In this practice, you explore the **dom0** configuration and directory structure.

Tasks

Perform the following steps:

1. Log in to the system by using a VNC client with the password `vnctech`.

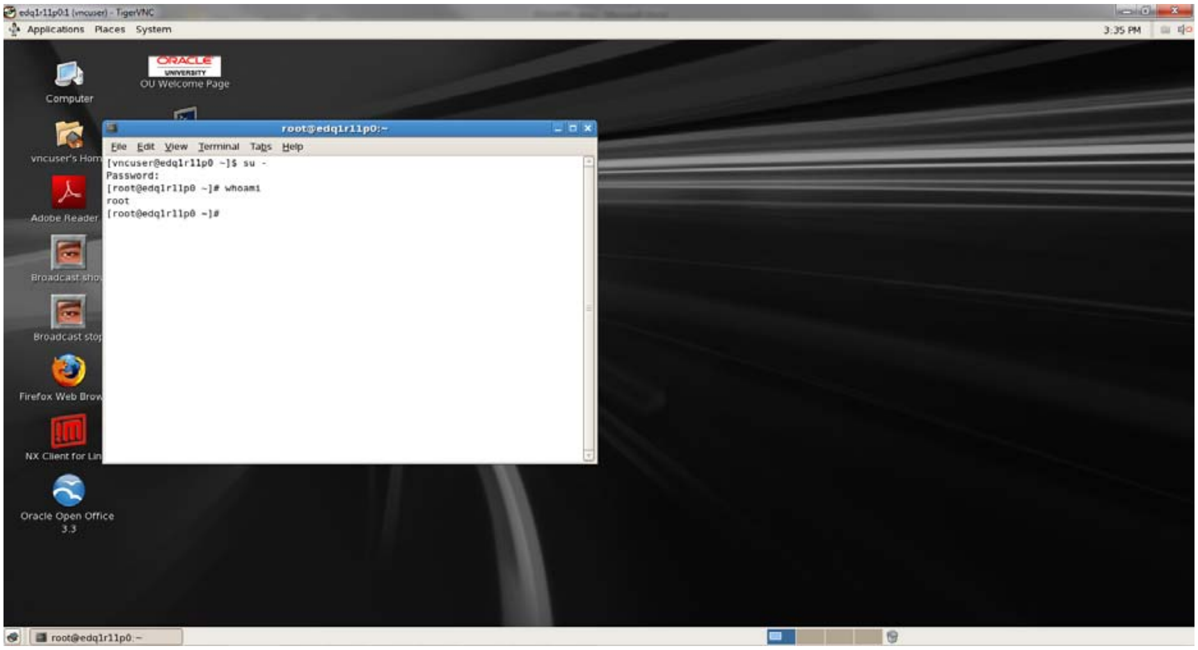
   Begin this task from the **dom0** GNOME desktop window as shown in the following screenshot:

2. Open a terminal window and assume the `root` role.

```
$ su -
Password: <Enter password assigned to you>
# whoami
root
```

   Note: The `root` password for the host machine is *`OU<gseventid+100>`*.

   The following screenshot illustrates the command entry:



3. Display the details of **dom0**.

```
# cat /etc/ovs-release
Oracle VM server release 3.2.1
```

4. Determine the network configuration of **dom0**.

```
# ifconfig -a
...
bond0     Link encap:Ethernet ...
          inet addr:10.190.66.208 ...
...
eth0      Link encap:Ethernet ...
...
lo        Link encap:Local Loopback
          inet addr:127.0.0.1
...
virbr0    Link encap:Ethernet
          inet addr:192.168.1.1
...
```

In this example:

- The network interface of **dom0** is assigned an IP address of `10.190.66.208`
  - **Note:** The IP address of your system can be different.
- The `virbr0` interface is a `xen` bridge used by the VM guests. It is assigned an IP address of `192.168.1.1`.
- The `vif<#>.<#>` entries are virtual interfaces associated with the VM

5. Explore the `/OVS` directory structure of **dom0**.
   a. Explore the top level of the `/OVS` directory.

```
# ls -l /OVS
drwxr-xr-x     2 root root 4096 Oct  27    17:26 iso_pool
drwxr-xr-x     2 root root 4096  Oct  19    17:26 publish_pool
drwxr-xr-x    15 root root 4096  Oct  17    17:41 running_pool
drwxr-xr-x     2 root root 4096  Oct  19    17:26 seed_pool
drwxr-xr-x     2 root root 4096  Oct  19    17:26 sharedDisk
```

   b. Explore the `/OVS/running_pool` directory.

```
# cd /OVS/running_pool
# ls -l
drwxr-xr-x      ...   s11-client1
drwxr-xr-x      ...   s11-client2
drwxr-xr-x      ...   s11-client3
drwxr-xr-x      ...   s11-client4
drwxr-xr-x      ...   s11-desktop
drwxr-xr-x      ...   s11-server1
```

   The preceding output displays a directory structure where each directory signifies an individual VM that is part of the **dom0** environment.

   c. Explore the contents of the directory related to the **s11-server1** VM.

```
# cd /OVS/running_pool/s11-server1
# ls -l
-rw-r--r--      ...   s11-server1_disk1.img
-rw-r--r--      ...   s11-server1_disk2.img
-rw-r--r--      ...   s11-server1_disk3.img
-rw-r--r--      ...   s11-server1_disk4.img
-rwxr-xr-x      ...   vm.cfg
```

   In the preceding output:

   - The `s11-server1_disk1.img` file is the operating system disk
   - The disk files `s11-server1_disk2.img` through `s11-server1_disk4.img` are utility disks that are used in various practices in this course
   - The `vm.cfg` file is the configuration file for the virtual machine. This file is read when the virtual machine is created

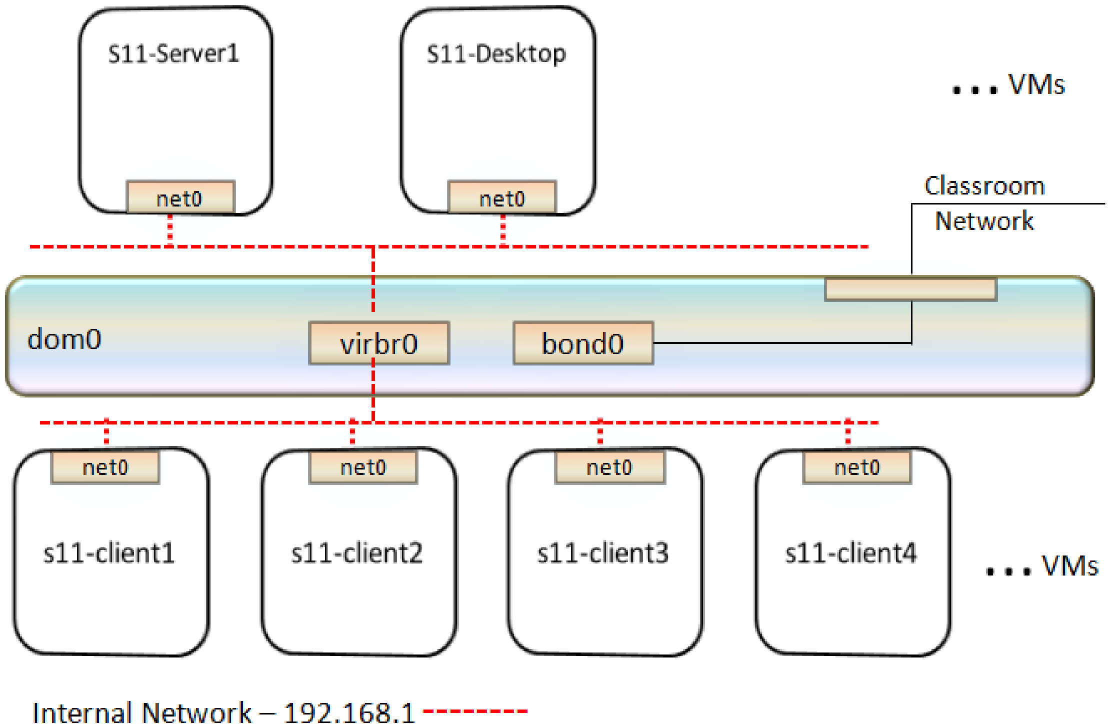
6. Explore the `vm.cfg` configuration file of the **s11-server1** VM.

```
# cat vm.cfg
VM_simple_name = ‘s11-server1’
vnclisten = ‘0.0.0.0’
serial = ‘pty’
name = ‘s11-server1’
builder = ‘hvm’
memory = 2048
boot = ‘cd’
```

```
disk = [    'file:/OVS/running_pool/s11-server1/s11-
server1_disk1.img,xvda,w',',xvdb:cdrom,r',
            'file:/OVS/running_pool/s11-server1/s11-server1_disk2.img,xvdc,w',
            'file:/OVS/running_pool/s11-server1/s11-server1_disk3.img,xvdd,w',
            'file:/OVS/running_pool/s11-server1/s11-server1_disk4.img,xvde,w'
vif = [     'mac=00:16:3e:00:01:02, bridge=virbr0',
            'mac=00:16:3e:00:02:01, bridge=virbr0',
            'mac=00:16:3e:00:03:01, bridge=virbr0',
            'mac=00:16:3e:00:04:01, bridge=virbr0' ]
vncunused = 1
uuid = ''
cpu_weight = 27500
cpu_cap = 0
vcpus = 1
maxvcpus = 4
vnc = 1
OVM_description = ''
on_poweroff = 'destroy'
on_reboot = 'restart'
on_crash = 'restart'
guest_os_type = 'default'
keymap = 'en-us'
OVM_os_type = 'Oracle Solaris 11'
OVM_domain_type = 'xen_hvm'
usb = 1
usbdevice = 'tablet'
```

Note: There is a unique `vm.cfg` file for each VM in the **dom0** environment that defines the VM's configuration. You will access and edit this file often while performing the various practices in this course.

The following network topology diagram displays the configuration of the practice infrastructure:



Note: Internet access is not configured for these VMs.

Practice 1-2: Starting, Stopping, and Listing Guest VMs, and Starting VNC Sessions

Overview

In this practice, you use `xm` commands to list, create, and shut down virtual machines.

Tasks

1. Ensure that you are logged in to **dom0**. Open a terminal window and log in as the `root` user.
2. Use the `xm list` command to list all currently active guests, as well as **dom0** itself.

```
# xm list
Name          ID       Mem    VCPUs     State       Time(s)
Domain-0       0       1024       4     r-----      7427.2
```

   As of now, you have no guest VMs running.

3. Start the s11-server1 and s11-desktop VM.

   Use the `xm create <config_file>` command to start the VMs. `<config_file>` is named `vm.cfg` and is located in the `/OVS/running_pool/<VM_name>` directory. Run `xm list` to display the running VMs.

```
# xm create /OVS/running_pool/s11-server1/vm.cfg
Using config file "./vm.cfg".
Started domain s11-server1 (id=8)
# xm create /OVS/running_pool/s11-desktop/vm.cfg
Using config file "./vm.cfg".
Started domain s11-desktop (id=9)
# xm list
Name          ID       Mem    VCPUs     State       Time(s)
Domain-0       0       1024       4     r-----       7448.2
s11-desktop    9       2304       1     -b----          0.3
s11-server1    8       2048       1     -b----         31.7
```

   - Note that **s11-server1** and **s11-desktop** are now active.
   - The State column for **dom0** and **s11-desktop** shows '`r`' (run state). The State column for **s11-server1** shows '`b`' (blocked). The following describes these values:
     – `r`: The domain is currently running and healthy
     – `b`: The domain is blocked, and not running or runnable. This can be because the domain is waiting on IO (a traditional wait state) or has gone to sleep because there was nothing else to do. (If the VM shows "`r`", it is because you have just booted it up. It will become blocked in a few seconds.)

4. Shut down a VM.

   Use the `xm shutdown –w <VM name>` command to shut down the **s11-desktop** VM. The `–w` option tells the system to wait until all services in the domain are shut down cleanly. Run `xm list` to display the running VMs.

```
# xm shutdown –w s11-desktop
Domain s11-desktop terminated
```

```
All domains terminated
# xm list
Name          ID      Mem    VCPUs     State      Time(s)
Domain-0       0     1024        8    r-----     94755.6
s11-server1   25     4096        1    -b----      2998.5
```

The `xm shutdown` command takes a few seconds to complete.

Alternatively, use the `xm destroy <VM-name>` command to terminate a VM immediately. You might want to terminate a VM immediately if the VM hangs or you are unable to gain access to the VM, or you are not sure of the state of the VM.

```
# xm destroy s11-desktop
```

5. Connect to **s11-desktop** guest by using vncviewer. Restart the VM first.

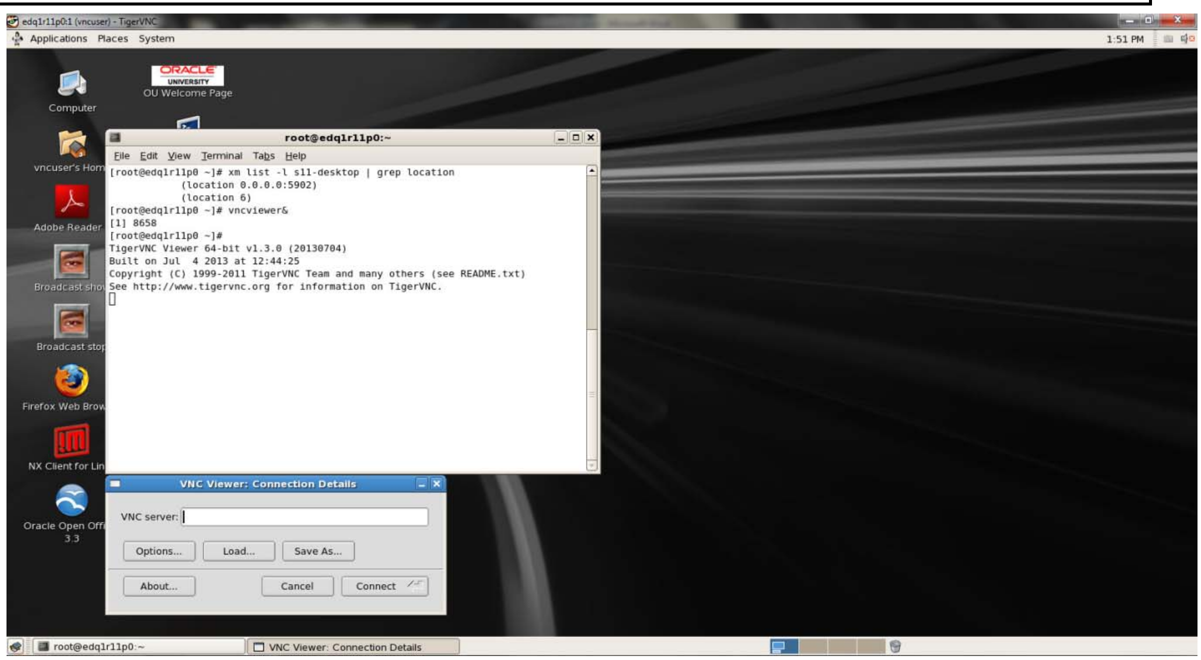
   a. From **dom0**, determine the VNC port number for **s11-desktop** after restarting it.

```
# xm create /OVS/running_pool/s11-desktop/vm.cfg
# xm list -l s11-desktop | grep location
                (location 0.0.0.0:5902)
                (location 6)
```

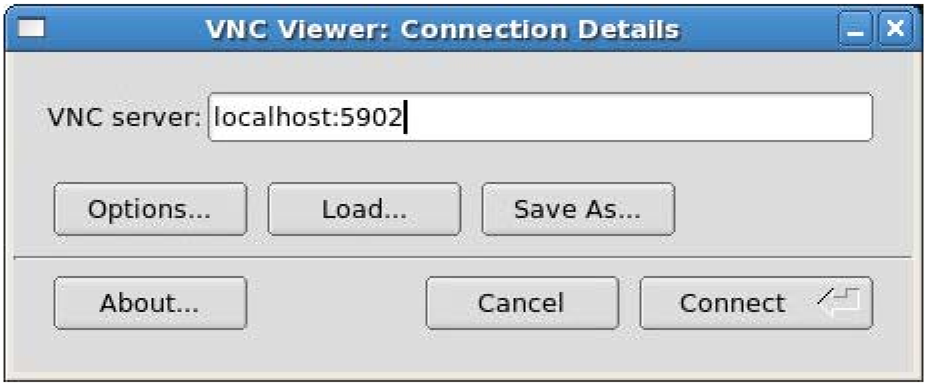
   The example shows that the port number is **5902**.

   b. From **dom0**, run the `vncviewer&` command. A Connection Details dialog box is displayed:

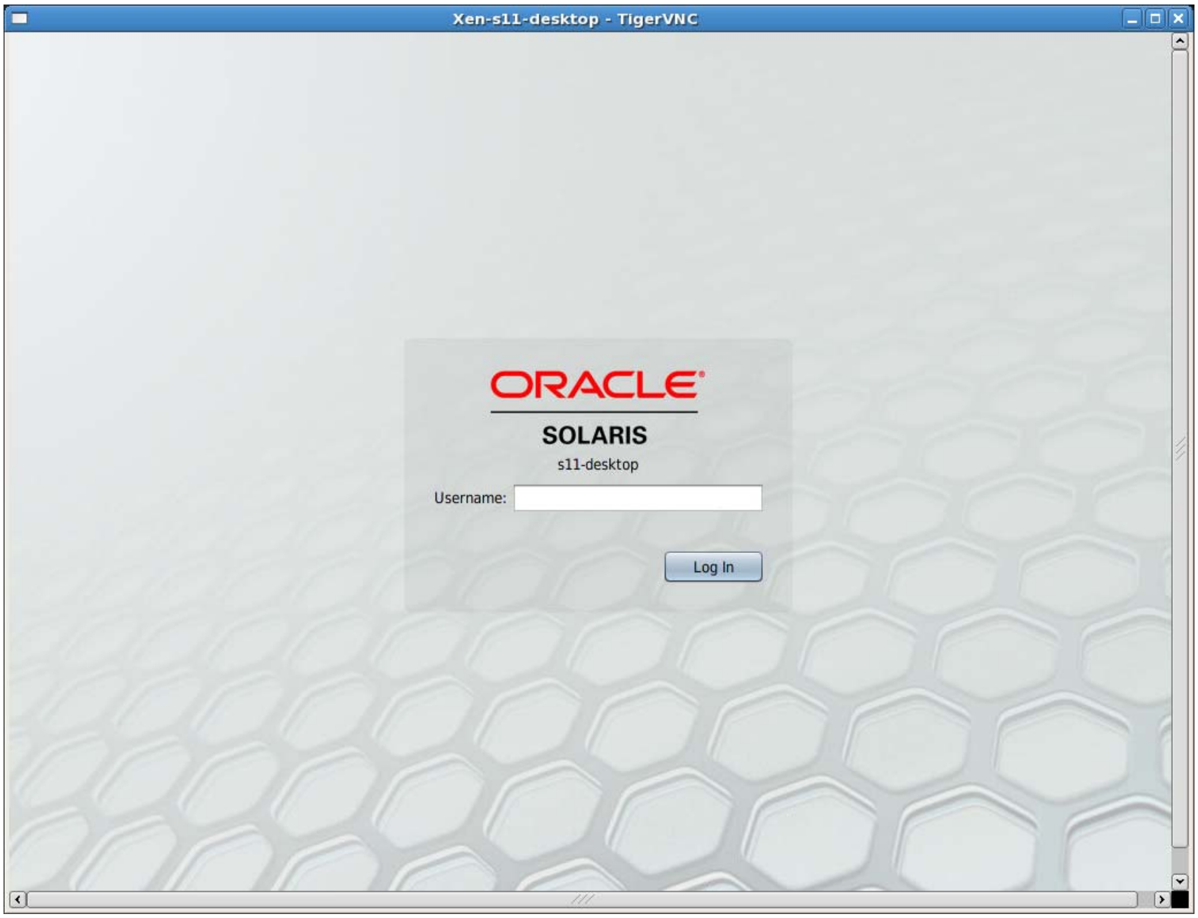
```
# vncviewer&
```



   c. Enter the `localhost:<port_number>` command, substituting the port number displayed from the previous `xm list` command. For example, if the port number is `5902`, enter `localhost:5902` and click **Connect**.

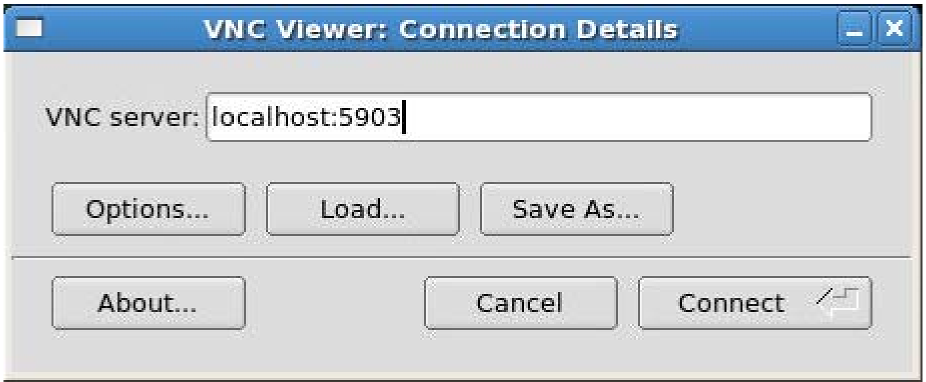


d. The following window is displayed where you enter the login credentials for the **s11-desktop** VM.

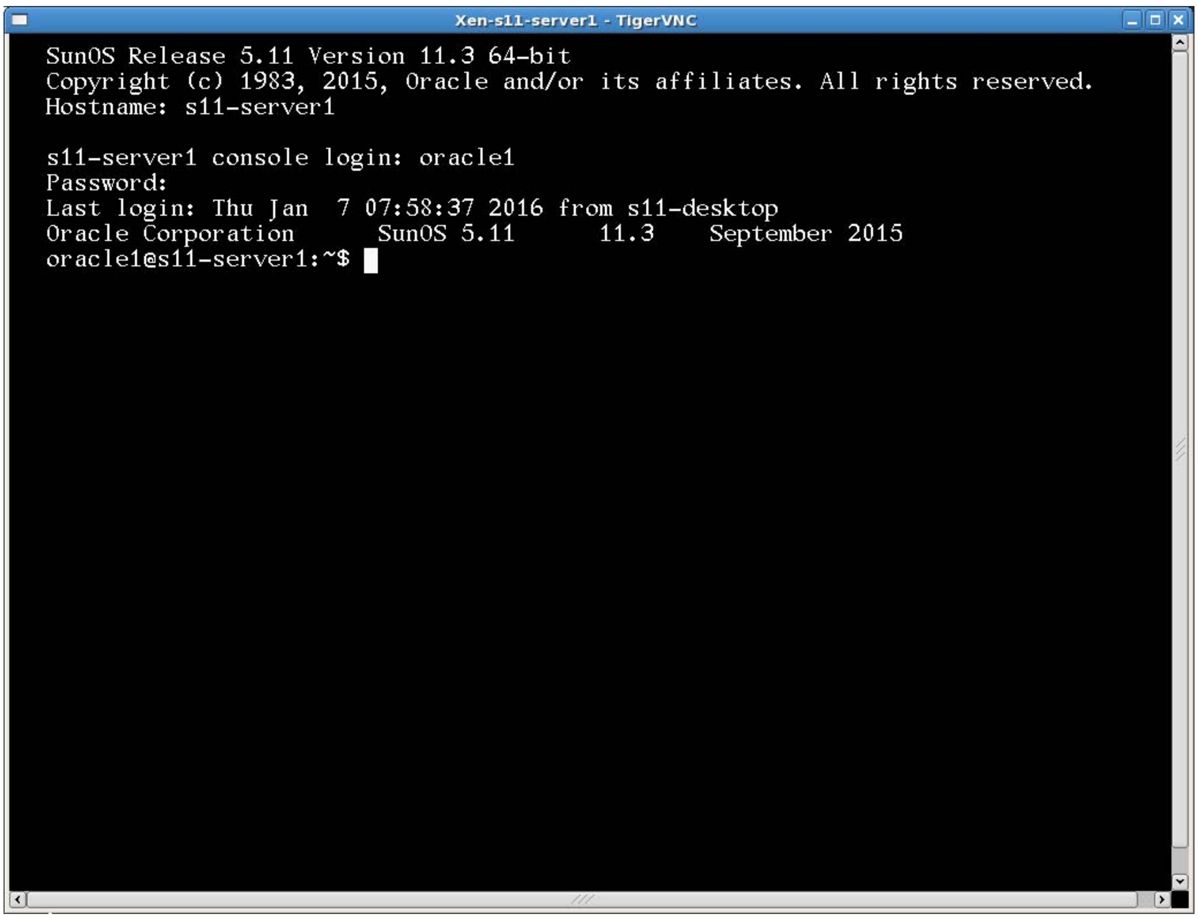


6. Repeat the steps listed in step 5 for the **s11-server1** guest VM.

```
# xm list -l s11-server1 | grep location
                (location 0.0.0.0:5903)
                (location 6)
# vncviewer&
```



a. The following window is displayed, which is a VNC session of the s11-server1 VM that was running already.



7. You can close the VNC session by clicking the **X** at the top-right corner of the window. This does not shut down the VM. To shut down the VM, use the `xm shutdown -w` <*VM_name*> command.

Practices for Lesson 2: Managing Services and Service Properties Using SMF

Chapter 2

Practices for Lesson 2: Overview

Practices Overview

In these practices, you are given a plan for configuring, restoring, and maintaining the Oracle Solaris 11 services and getting acquainted with various service profiles.

According to the predeployment plan, the time has come for you to evaluate the Service Management Facility (SMF) services. You have been tasked with working with multiple scenarios to test the SMF functionality. In support of your business applications, in certain cases, you may have to create, troubleshoot, and modify the services and service profiles.

The key areas explored in the practices are:

- Configuring SMF services
- Restoring and recovering a service
- Working with service profiles

Note: In many cases, your command output displays may be different from the displays in the practice. Some examples would be storage, process IDs, and session-oriented and system-generated information.

Check your progress. You will now start working with SMF services.

	Oracle Solaris 11 Predeployment Checklist
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	Managing Software Packages by Using IPS
	Managing Data Backup and Restore by Using ZFS
	Configuring the Network
	Administering Network Services
	Advanced Administration of Zones
	Securing the Oracle Solaris 11 OS
	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practice 2-1: Configuring SMF Services

Overview

As part of the predeployment testing plan, you are given the task of creating a simple service that can also assist you in modifying a service. You will call this new service `crmsvc`, which has been designed to monitor the CRM processes. In addition, you will also modify the environment variables and properties of the actively running services. For example, you will determine any memory leaks caused by the running programs and turning on the TCP trace.

In this practice, you work with SMF services in the following areas:

- Creating and exporting a service
- Modifying a service
- Changing an environment variable for a service
- Changing a property for a service controlled by `inetd`

Task 1: Creating and Exporting a Service

1. Start the S11-Server1 and S11-Desktop VMs and log in to S11-Desktop VM with the user ID `oracle` and password `oracle1`.
2. On S11-Desktop VM, right-click the desktop background and open a terminal window.
3. In the terminal window, run the `su -` command to assume administrator privileges.

```
oracle@s11-desktop:~$ su -
Password:
Oracle Corporation      SunOS 5.11          11.3     September 2015
root@s11-desktop:~#
```

4. Verify that user `sstudent` exists.
   If not, create `sstudent`, and then confirm that the user has been created.

```
root@s11-desktop:~# tail /etc/passwd
…
…
sstudent:x:60008:10:super student:/export/home/sstudent:/bin/sh
```

Note: The user `sstudent` has been created so that you can create a new service as a non-administrative user. Because you must have the appropriate privileges, you will perform some steps as an administrative user.

If `sstudent` does not exist, run the following command:

```
root@s11-desktop:~# useradd -u 60008 -g 10 -d \ /export/home/sstudent
-m -s /bin/bash -c "super student" sstudent
```

5. As the `sstudent` user, create the `smf` directory in your home directory. Create a file called `monitor.crm` with the contents shown below. Finally, grant the execute permission on the script.

```
root@s11-desktop:~# su - sstudent
Oracle Corporation      SunOS 5.11       11.3        September 2015
sstudent@s11-desktop:~$ pwd
```

```
/export/home/sstudent
sstudent@s11-desktop:~$ mkdir smf
sstudent@s11-desktop:~$ ls
local.cshrc  local.login  local.profile  smf
sstudent@s11-desktop:~$ cd smf
sstudent@s11-desktop:~/smf$ vi monitor.crm
#!/bin/sh
echo "crm monitoring service" > /export/home/sstudent/smf/crmrep
~
~
~
:wq

sstudent@s11-desktop:~/smf$ exit
root@s11-desktop:~# cd /export/home/sstudent/smf
root@s11-desktop:/export/home/sstudent/smf# chown sstudent \
monitor.crm
root@s11-desktop:/export/home/sstudent/smf# su - sstudent
Oracle Corporation      SunOS 5.11 11.3    September 2015
sstudent@s11-desktop:~$ cd smf
sstudent@s11-desktop:~/smf$ cat monitor.crm
#!/bin/sh
echo "crm monitoring service" > /export/home/sstudent/smf/crmrep
sstudent@s11-desktop:~/smf$ chmod 774 monitor.crm
```

After creating the script, you are granted the execute permission on the script so it can be executed.

6. Exit the `sstudent` user account to return to the administrative user to configure the service. Use the `svccfg` command to copy an existing service to serve as a template.

```
sstudent@s11-desktop:~/smf$ exit
root@s11-desktop:/export/home/sstudent/smf# cd
root@s11-desktop:~# svccfg export system/utmp > \
/var/svc/manifest/site/crmsvc.xml
```

Instead of starting the manifest file from the beginning, you will have this template to work with.

7. Edit the `crmsvc.xml` file to match the contents displayed. Your file should match these contents *exactly*, so make sure that you delete all unnecessary tags from the template.

```
root@s11-desktop:~# pfedit /var/svc/manifest/site/crmsvc.xml
<?xml version='1.0'?>
<!DOCTYPE service_bundle SYSTEM
'/usr/share/lib/xml/dtd/service_bundle.dtd.1'>
<service_bundle type='manifest' name='crmsvc'>
  <service name='site/crmsvc' type='service' version='1'>
```

```
    <create_default_instance enabled='false'/>
    <single_instance/>
```

[Make sure you delete the dependency, dependent tags, and method tags.]

```
    <exec_method name='start' type='method'
exec='/export/home/sstudent/smf/monitor.crm'
timeout_seconds='60'/>
    <exec_method name='stop' type='method' exec=':true'
timeout_seconds='60'/>
```

[Make sure you delete the stability value, template tags, and their associated information.]

Add the following content.

```
     <property_group name='startd' type='framework'>
            <propval name='duration' type='astring' value='transient'/>
    </property_group>
  </service>
</service_bundle>
```

After editing, the manifest for your test service should look like this. Review the contents for any XML tags missing, and any typing errors. Notice that `exec_method` matches up with your program.

8. Validate the manifest file by using the `svccfg validate` command.

```
root@s11-desktop:~# svccfg validate /var/svc/manifest/site/crmsvc.xml
```

Unless there are any spelling mistakes, the `validate` command should run fine.

9. By using the `svcadm restart` command, make the manifest available to SMF.

```
root@s11-desktop:~# svcadm restart system/manifest-import
```

Because the service you created is in an SMF standard manifest directory, you can just restart the manifest service. This will import the newly created service. You don't have to import the service individually. This is the recommended practice.

10. Display the service by using the `svcs` command. If it is disabled, enable it by using the `svcadm` command.

```
root@s11-desktop:~# svcs crmsvc
disabled       13:14:07 svc:/site/crmsvc:default

root@s11-desktop:~# svcadm enable svc:/site/crmsvc:default
root@s11-desktop:~# svcs crmsvc
STATE          STIME    FMRI
online         13:43:36 svc:/site/crmsvc:default
```

Is your service enabled and online? *Yes.*

11. Now verify that the command `echo` was executed by using the new service.

```
root@s11-desktop:~# cat /export/home/sstudent/smf/crmrep
crm monitoring service
```

The action you had specified in `monitor.crm` was executed by bringing up the service resulting in echoing the above string to the `crmrep` file. This is how you can execute a program as a service.

Task 2: Modifying a Service Configuration

The following tasks will introduce the various types of service modifications (for example, the service environment variables, network service properties, and process-to-service conversion).

In this practice, you will work with SMF services in the following areas:

- Changing an environment variable for a service
- Changing a property of a service controlled by `inetd`

Task 2A: Changing an Environment Variable for a Service

1. Verify whether the S11-Desktop VM is running.
2. Use the `svcs` command to check whether the `cron` service is running.

```
root@s11-desktop:~# svcs system/cron
STATE          STIME    FMRI
online          6:52:52 svc:/system/cron:default
```

The `cron` service is up and running.

Note: If the `cron` service is in the disabled state, you can enable it by running the following command:

`# svcadm enable svc:/system/cron:default`

3. Use the `svccfg` command to modify the memory environment variables for the `cron` service.

```
root@s11-desktop:~# svccfg -s system/cron:default setenv \
UMEM_DEBUG default
root@s11-desktop:~# svccfg -s system/cron:default setenv \
LD_PRELOAD libumem.so
```

The two environment variables are configured for the `cron` service for debugging the memory leaks while the `cron` service is executing a program.

4. Refresh and restart the `cron` service by using the `svcadm` command to make the changes effective.

```
root@s11-desktop:~# svcadm refresh system/cron
root@s11-desktop:~# svcadm restart system/cron
```

5. Verify that the environment variables have been modified.

   Note: Use the *back tick* key on the keyboard to enclose the `pgrep` command. Look for the back tick below the tilde (~) key on the keyboard.

```
root@s11-desktop:~# pargs -e `pgrep -f /usr/sbin/cron`
1593:      /usr/sbin/cron
…
…
envp[10]: LD_PRELOAD=libumem.so
…
…
envp[19]: UMEM_DEBUG=default
envp[20]: A__z="*SHLVL
```

   Your display may be slightly different.

   Are the configured environment variables displayed in the output? *Yes,* `envp[10]` *and* `envp[19]` *show the new values.*

   This command is helpful when you need to debug or monitor programs for memory leaks.

   To find the memory leaks in the programs, you need knowledge of Oracle Solaris debugging tools, such as `mdb`. The debugging topic is covered in more specialized courses, such as *Oracle Solaris 11 Performance Management*.

Task 2B: Changing a Property for an `inetd`-Controlled Service

1. Verify that the Sl11-Server1 VM is running. If it is not, start it now.
2. In the S11-Desktop VM, close all terminal windows and open a new terminal window.
3. In the terminal window, start an `ssh` session to S11-Server1 as the `oracle` user. Use the password `oracle1`.

```
oracle@s11-desktop:~# ssh oracle@192.168.1.100
```

   Note: For any RSA-related message, enter `yes`.

```
Password: oracle1
Last login: Tue Sep 17 06:08:26 2015
Oracle Corporation       SunOS 5.11         11.3   September 2015
```

4. Assume administrator privileges.

```
oracle@s11-server1:~$ su -
Password: oracle1
Oracle Corporation        SunOS 5.11       11.3   September 2015
root@s11-server1:~#
```

5. By using the `inetadm` command, list the properties of the `telnet` service.

```
root@s11-server1:~# inetadm -l svc:/network/telnet:default
SCOPE    NAME=VALUE
         name="telnet"
```

```
         endpoint_type="stream"
         proto="tcp6"
         isrpc=FALSE
         wait=FALSE
         exec="/usr/sbin/in.telnetd"
         user="root"
default  bind_addr=""
default  bind_fail_max=-1
default  bind_fail_interval=-1
default  max_con_rate=-1
default  max_copies=-1
default  con_rate_offline=-1
default  failrate_cnt=40
default  failrate_interval=60
default  inherit_env=TRUE
default  tcp_trace=FALSE
default  tcp_wrappers=FALSE
default  connection_backlog=10
default  tcp_keepalive=FALSE
```

Is the `tcp_trace` property for `telnet` enabled? *No, because it says `FALSE` in the entry.*

6. Use the `inetadm` command to enable `tcp_trace` on the `telnet` service. Confirm the action.

```
root@s11-server1:~# inetadm -m svc:/network/telnet:default \
tcp_trace=TRUE
root@s11-server1:~# inetadm -l svc:/network/telnet:default
SCOPE    NAME=VALUE
         name="telnet"
…
…
default  inherit_env=TRUE
         tcp_trace=TRUE
default  tcp_wrappers=FALSE
default  connection_backlog=10
default  tcp_keepalive=FALSE
```

Why do you need to turn on `tcp_trace`? *So the `telnet` connections can be monitored.*

Is the `tcp_trace` enabled now for the `telnet` service? *Yes.*

7. Enable the `telnet` service by using the `svcadm` command.

```
root@s11-server1:~# svcadm enable network/telnet
```

8. Start verifying the `tcp_trace` by using the `telnet` command to connect to the `localhost` and the `exit` command to log out.

```
root@s11-server1:~# telnet localhost
Trying ::1...
Connected to localhost.
Escape character is '^]'.
login: oracle
Password: oracle1
Last login: Wed Sep 18 07:08:43 from s11-desktop.myd
Oracle Corporation      SunOS 5.11       11.3   September 2015
oracle@s11-server1:~# exit
logout
Connection to localhost closed by foreign host.
```

Because you created the connection, you can check if the `tcp_trace` property is logging the message.

9. Check whether any message was logged in the `/var/adm/messages` file.

```
root@s11-server1:~# tail -1 /var/adm/messages
Sep 16 08:27:57 s11-server1 inetd[787]: [ID 317013 daemon.notice]
telnet[13363] from ::1... 57330
```

Note: `-1` in the command is the digit *one*. In case the `tail -1` command does not display the expected output, run the `tail -10 /var/adm/messages` command.

By using the `tail` command with the `-1` option, you display the last or most current message.

Is the `telnet` connection logged? *Yes.*

10. Confirm the entry in `/etc/syslog.conf`, which is configured to log this message.

```
root@s11-server1:~# grep /var/adm/messages /etc/syslog.conf
*.err;kern.debug;daemon.notice;auth.notice;mail.crit /var/adm/messages
user.err                                         /var/adm/messages
```

Notice that the `daemon.notice` facility messages are configured to be written to `/var/adm/messages`. Who is writing the trace messages to `/var/adm/messages`? *The `syslogd` daemon*

11. Exit the `ssh` session to S11-Server1 VM.

```
root@s11-server1:~# exit
logout
oracle@s11-server1:~# exit
logout
Connection to 192.168.1.100 closed.
oracle@s11-desktop:~$
```

Task 2C: Modifying the Manifest for a Service

1. In the Sol11-Desktop terminal window, run the `su -` command to assume administrator privileges.

```
oracle@s11-desktop:~$ su -
Password: oracle1
Oracle Corporation      SunOS 5.11       11.3        September 2015
root@s11-desktop:~#
```

2. By using the `svcs` command, check the status of the `crmsvc` service you created earlier in Practice 2-1, Task 1. Disable the service and display the result.

   Note: If the `crmsvc` service should appear in a maintenance state when you run the `svcs crmsvc` command the first time, disable the service, refresh it, and then enable it to bring it back into an online state.

```
root@s11-desktop~# svcs crmsvc
online         10:04:44 svc:/site/crmsvc:default
root@s11-desktop:~# svcadm disable crmsvc
root@s11-desktop:~# svcs crmsvc
STATE          STIME    FMRI
disabled       10:07:59 svc:/site/crmsvc:default
```

Notice that at this time, `crmsvc` is disabled.

3. Use the `cd` command to switch to the `sstudent`'s `smf` directory. Display the directory's contents.

```
root@s11-desktop~# cd /export/home/sstudent/smf;ls
crmrep   monitor.crm
```

4. By using the `cp` command, copy the `monitor.crm` file as `monitor1.crm`. By using the `pfedit` command, modify the contents of `monitor1.crm` as shown in the following:

```
root@s11-desktop:/export/home/sstudent/smf# cp monitor.crm \
monitor1.crm
root@s11-desktop:/export/home/sstudent/smf# pfedit monitor1.crm
#!/bin/sh
echo "Here is your modified crm monitoring service" >
/export/home/sstudent/smf/crmrep
:wq
```

Your modified service should record this new message in the `crmrep` file.

5. Use the `cd` command to switch to the manifest directory. Edit `crmsvc.xml` to refer to `monitor1.crm` instead of `monitor.crm`.

```
root@s11-desktop:/export/home/sstudent/smf# cd \
/var/svc/manifest/site
root@s11-desktop:/var/svc/manifest/site# ls
crmsvc.xml
root@s11-desktop:/var/svc/manifest/site# pfedit crmsvc.xml
root@s11-desktop:/var/svc/manifest/site# cat crmsvc.xml | grep \
monitor1
    <exec_method name='start' type='method'
exec='/export/home/sstudent/smf/monitor1.crm' timeout_seconds='60'/>
root@s11-desktop:/var/svc/manifest/site# cd
root@s11-desktop:~#
```

6. By using the `svcadm` command, restart the `manifest-import` service. Enable `crmsvc` and confirm that the service is online.

```
root@s11-desktop:~# svcadm restart manifest-import
root@s11-desktop:~# svcadm restart crmsvc
root@s11-desktop:~# svcadm enable crmsvc
root@s11-desktop:~# svcs crmsvc
STATE          STIME     FMRI
online          10:27:25 svc:/site/crmsvc:default
```

The service is online.

7. By using the `cat` command, display the new contents of the report.

```
root@s11-desktop:~# cat /export/home/sstudent/smf/crmrep
Here is your modified crm monitoring service
```

What was the purpose of modifying the service manifest? *To demonstrate that these are the steps you take to modify an existing service. The modified service is executing a different program `monitor1.crm`.*

Practice 2-2: Working with Service Profiles

Overview

In this practice, you evaluate the current service profile. Based on your business application environment, you want to make sure that only the required services are enabled at the system startup. In addition, you learn how to limit remote access to your host by using a network profile. The following activities are addressed:

- Creating an SMF profile
- Applying an SMF profile
- Changing the services and their configuration by using the `netservices` command

Tasks

1. Verify that S11-Desktop VM is running and you have assumed administrator privileges.
2. Use the `svcs` command to check the current status of the `cups/scheduler` service.

```
root@s11-desktop:~# svcs cups/scheduler
STATE          STIME    FMRI
online         16:48:33 svc:/application/cups/scheduler:default
```

Currently, the service is enabled.

3. Use the `svccfg extract` command to copy the currently active SMF profile into a file called `profile.xml`.

```
root@s11-desktop:~# svccfg extract > profile.xml
```

Note: The command takes a minute to complete.

4. By using the `pfedit` command, modify the extracted `profile.xml` file.
   - Change the `service_bundle` name from `extract` to `profile`.
   - Change the `enabled` property of the `application/cups/scheduler` service from `true` to `false`.

```
root@s11-desktop:~# pfedit profile.xml
<?xml version='1.0'?>
<!DOCTYPE service_bundle SYSTEM
'/usr/share/lib/xml/dtd/service_bundle.dtd.1'>
<service_bundle type='profile' name='profile'>
…
…
…
<service name='application/cups/scheduler' type='service' version='0'>
    <instance name='default' enabled='false'>
      <property_group name='startup' type='application'>

         <propval name='gutenprint' type='astring' value='5.2.7,5.11-
0.175.3.0.0.30.0:20150821T171349Z'/>

      </property_group>
```

```
    </instance>
  </service>
…
…
…
```

After you apply the configuration, this `cups/scheduler` service will be disabled.

5. Use the `svccfg` command to apply the modified profile.

```
root@s11-desktop:~# svccfg apply profile.xml
```

Note: Allow the OS to apply the changes. It will take a few minutes.

```
root@s11-desktop:~# svcs cups/scheduler
disabled       16:48:33 svc:/application/cups/scheduler:default
```

Notice that the `cups/scheduler` service is disabled.

Refresh and then enable the service by using the `svcadm enable` command. As a last step, verify that the service is now back online.

```
root@s11-desktop:~# svcadm refresh cups/scheduler
root@s11-desktop:~# svcadm enable cups/scheduler
root@s11-desktop:~# svcs cups/scheduler
online       16:50:15 svc:/application/cups/scheduler:default
```

Note: It might take up to 5 minutes to bring up the service.

The service is again enabled.

Practice 2-3: Restoring and Recovering a Service

Overview

Your predeployment test plan calls for various SMF service scenarios. In this practice, most of the repair and restore scenarios, when a service or the SMF repository has become defective, are covered. The following areas will be addressed in this practice:

- Restoring a service in the `maintenance` state
- Reverting to a previous SMF snapshot
- Repairing a corrupt repository
- Debugging a service that is not starting

Task 1: Restoring a Service in the `maintenance` State

Now you look at a service that is in the `maintenance` state. In a training scenario such as this, you will make a spelling error in the service manifest file, and observe the service going into the `maintenance` state and correct the problem.

1. Verify that the S11-Desktop VM is running and you have assumed the administrator privileges.
2. Use the `svcs` command to check whether the `crmsvc` service is running.

```
root@s11-desktop:~# svcs crmsvc
STATE          STIME    FMRI
online          10:27:25 svc:/site/crmsvc:default
```

3. By using the `pfedit` command, delete the last letter 'm' from the file name `monitor1.crm` in the `method` block as indicated. Save the changes.

```
root@s11-desktop:~# cd /var/svc/manifest/site
root@s11-desktop:/var/svc/manifest/site# pfedit crmsvc.xml
<?xml version='1.0' encoding='UTF-8' ?>
<!DOCTYPE service_bundle SYSTEM
'/usr/share/lib/xml/dtd/service_bundle.dtd.1'>
<service_bundle type='manifest' name='crmsvc'>
  <service name='site/crmsvc' type='service' version='1'>
    <create_default_instance enabled='false'/>
    <single_instance/>
    <exec_method name='start' type='method'
exec='/export/home/sstudent/smf/monitor1.cr'
…
…
…
:wq
root@s11-desktop:/var/svc/manifest/site# cd
root@s11-desktop:~#
```

This will create a problem because the `crmsvc` program will not be able to process the misspelled argument '`monitor1.cr`'. This scenario is realistic and representative of the real world because typing errors can happen.

4. See if you can bring this service up. Refresh the `manifest-import` service, which will automatically refresh the `crmsvc` configuration.

```
root@s11-desktop:~# svcadm restart manifest-import
root@s11-desktop:~# svcs crmsvc
STATE          STIME    FMRI
online         10:27:25 svc:/site/crmsvc:default
root@s11-desktop:~# svcadm restart crmsvc
root@s11-desktop:~# svcs crmsvc
STATE          STIME    FMRI
maintenance    10:27:25 svc:/site/crmsvc:default
root@s11-desktop:~# svcadm clear crmsvc
root@s11-desktop:~# svcs crmsvc
STATE          STIME    FMRI
maintenance    10:27:25 svc:/site/crmsvc:default
```

When trying to clear the `maintenance` state, it still stays in the existing `maintenance` state. When the Service Management Facility (SMF) places a service in `maintenance` mode, SMF is unable to bring it up. A system administrator has to debug the problem.

5. Use the `svcs` command with the `–xv` option and that will give you some debugging details.

```
root@s11-desktop:~# svcs -xvL crmsvc
svc:/site/crmsvc:default (?)
 State: maintenance since September 16, 2015 09:01:35 AM UTC
Reason: Start method failed repeatedly, last exited with status 127.
   See: http://support.oracle.com/msg/SMF-8000-KS
   See: /var/svc/log/site-crmsvc:default.log
Impact: This service is not running.
   Log:
/usr/sbin/sh[1]: exec: /export/home/sstudent/smf/monitor1.cr: not found
[ Sep 16 09:01:15 Method "start" exited with status 127. ]
[ Sep 16 09:01:15 Executing start method
("/export/home/sstudent/smf/monitor1.cr"). ]
/usr/sbin/sh[1]: exec: /export/home/sstudent/smf/monitor1.cr: not found
[ Sep 16 09:01:15 Method "start" exited with status 127. ]
[ Sep 16 09:01:35 Leaving maintenance because clear requested. ]
[ Sep 16 09:01:35 Enabled. ]
[ Sep 16 09:01:35 Executing start method
("/export/home/sstudent/smf/monitor1.cr"). ]
/usr/sbin/sh[1]: exec: /export/home/sstudent/smf/monitor1.cr: not found
[ Sep 16 09:01:35 Method "start" exited with status 127. ]

   Use: 'svcs -Lv svc:/site/crmsvc:default' to view the complete log.
```

Here, you see details about the `crmsvc` service. The display tells you that there is a problem with the start method because it exited with status 127. You can get a more detailed log by running the `svcs –Lv crmsvc` command.

```
root@s11-desktop:~# tail /var/svc/log/site-crmsvc:default.log
```

```
...
...
...
/usr/sbin/sh[1]: exec: /export/home/sstudent/smf/monitor1.cr: not
found
Sep 16 19:08:50 Method “start” exited with status 127.
```

So now you can see the details in the log and it spells out that it cannot execute your script `monitor1.cr`.

6. Edit the `crmsvc.xml` file to correct the typing error. Refer to previous steps for editing content.

```
root@s11-desktop:~# cd /var/svc/manifest/site
root@s11-desktop:/var/svc/manifest/site# pfedit crmsvc.xml
<?xml version='1.0' encoding='UTF-8' ?>
<!DOCTYPE service_bundle SYSTEM
'/usr/share/lib/xml/dtd/service_bundle.dtd.1'>
<service_bundle type='manifest' name='crmsvc'>
  <service name='site/crmsvc' type='service' version='1'>
    <create_default_instance enabled='false'/>
    <single_instance/>
    <exec_method name='start' type='method'
exec='/export/home/sstudent/smf/monitor1.crm'
…
…
…
root@s11-desktop:/var/svc/manifest/site# cd
root@s11-desktop:~#
```

Here you edit the `crmsvc.xml` file and correct the spelling error from ‘`monitor1.cr`’ to ‘`monitor1.crm`’ in the method block.

7. Now can you bring up the service? Look at what needs to be done.

```
root@s11-desktop:~# svcadm restart manifest-import
root@s11-desktop:~# svcs crmsvc
STATE          STIME    FMRI
maintenance    11:27:25 svc:/site/crmsvc:default
root@s11-desktop:~# svcadm clear crmsvc
root@s11-desktop:~# svcs crmsvc
STATE          STIME    FMRI
online       11:27:25 svc:/site/crmsvc:default
```

Now the `crmsvc` service is up and you are back in business.
This completes the steps for managing a service in the `maintenance` state.

Task 2: Reverting to a Previous SMF Snapshot

This task introduces you to multiple snapshots of a service.

When a service is corrupted, it is really the current instance of that service that is nonoperational. In that case, one of the options would be to revert to a previous functional snapshot and correct the problem with that instance of the service. Because you have seen multiple corrupted services, only the steps you need to take to revert to a previous instance of a service are demonstrated to you here.

1. Verify whether S11-Desktop VM is running and you have assumed administrator privileges.
2. Take a look at the `console-login` service. Assume it is in the `maintenance` state.

```
root@s11-desktop:~# svcs console-login:default
online         18:15:32 svc:/system/console-login:default
```

Currently, the service is running. In the previous practice, you have already seen how to bring a service back to online state if it is in the maintenance state. In this practice, you will observe how to revert to the previous snapshot of a `console-login` service snapshot.

3. Use the `svccfg` utility to list the `console-login` service snapshots. Select the `previous` snapshot.

```
root@s11-desktop:~# svccfg
svc:> select system/console-login:default
svc:/system/console-login:default> listsnap
previous
running
start
svc:/system/console-login:default> revert previous
svc:/system/console-login:default> quit
```

In this step, you are reverting to the previous snapshot.

4. Use the `svcadm` commands to `refresh` and `restart` the service. Confirm it is up and running.

```
root@s11-desktop:~# svcadm refresh system/console-login:default
root@s11-desktop:~# svcadm restart system/console-login:default
root@s11-desktop:~# svcs console-login:default
online         18:15:32 svc:/system/console-login:default
```

The `refresh` option will update the SMF repository with the configuration information from the previous snapshot. After you perform the refresh, you can start the service.

Task 3: Repairing a Corrupt Repository

This task introduces you to multiple versions of the SMF repository, which contains all of the services. In Task 2, you reverted to a previous snapshot of one service. Here, you are reverting to a functional version of the whole repository. This procedure is useful if multiple services are corrupted and it is deemed more efficient to revert to an earlier functional repository. Because you have seen multiple corrupted services, here you are shown only the steps you need to take to revert to a previous functional version of the repository.

1. Verify whether S11-Desktop VM is running and you have assumed administrator privileges.
2. Take a look at the whole SMF service repository. If you have corrupted services, SMF would not be able to bring them up and offer you the relevant functionality, for example, the `ssh` and `telnet` services. In that case, you restore the SMF repository to an earlier version. Take a look at the commands.

   Note: The repository backup list on your system may differ. Choose from your list.

```
root@s11-desktop:~# cd /lib/svc/bin
root@s11-desktop:/lib/svc/bin# ./restore_repository
See http://support.oracle.com/msg/SMF-8000-MY for more information on the use
of this script to restore backup copies of the smf(5) repository.

If there are any problems which need human intervention, this script will
give instructions and then exit back to your shell.
./restore_repository[71]: [: /: arithmetic syntax error
The following backups of /etc/svc/repository.db exist, from
oldest to newest:

boot-20161026_153736
boot-20161026_093041
boot-20161103_050123
boot-20161103_051850
manifest_import-20161103_072904
manifest_import-20161103_075123
manifest_import-20161103_082718
manifest_import-20161103_083056

The backups are named based on their type and the time what they were taken.
Backups beginning with "boot" are made before the first change is made to
the repository after system boot.  Backups beginning with "manifest_import"
are made after svc:/system/manifest-import:default finishes its processing.
The time of backup is given in YYYYMMDD_HHMMSS format.

Please enter either a specific backup repository from the above list to
restore it, or one of the following choices:

     CHOICE          ACTION
     ----------------  ----------------------------------------------
     boot             restore the most recent post-boot backup
     manifest_import restore the most recent manifest_import backup
     -seed-           restore the initial starting repository  (All
                      customizations will be lost, including those
                      made by the install/upgrade process.)
     -quit-           cancel script and quit

Enter response [boot]: boot-20161103_051850
```

In this step, you are reverting to the service repository version created on November 03, 2016. A new version is created by SMF after any service configuration.

3. The system will respond as follows. If you would like to revert to the specified version, enter `yes`, otherwise `no`. In this training scenario, you enter `no`.

```
…
…
After confirmation, the following steps will be taken:

svc.startd(1M) and svc.configd(1M) will be quiesced, if running.
/etc/svc/repository.db
    -- renamed --> /etc/svc/repository.db_old_20161103_092830
/etc/svc/repository-boot-20161103_051850
    -- copied --> /etc/svc/repository.db
and the system will be rebooted with reboot(1M).

Proceed [yes/no]? no

Exiting...
root@s11-desktop:/lib/svc/bin# cd
root@s11-desktop:~#
```

Task 4: Debugging a Service That Is Not Starting (Optional)

So far, you have seen multiple faces of service corruption. While debugging other issues earlier, you have seen the `svcs –xv` command. However, it is demonstrated here more as a commonly used reference tool. The purpose is two-fold: first to demonstrate how to temporarily take a service out of operation; and second to quickly view some debugging information.

1. Verify that S11-Desktop VM is running and you have assumed administrator privileges.
2. Use the `svcs` command to check whether the `cron` service is running.

```
root@s11-desktop:~# svcs cron
STATE           STIME    FMRI
online          7:35:56 svc:/system/cron:default
```

3. Now take a look at a service that is in the `disabled` state. In a training scenario such as this, you will take the `cron` service offline temporarily and evaluate the debugging process.

```
root@s11-desktop:~# svcadm disable -t cron
root@s11-desktop:~# svcs cron
STATE           STIME    FMRI
disabled       11:04:39 svc:/system/cron:default
```

Can you guess what is the purpose of the `-t` option? *It temporarily disables the specified service.*

4. Use the `svcs` command to obtain details about the problems with the `cron` service.

```
root@s11-desktop:~# svcs -xvL cron
svc:/system/cron:default (clock daemon (cron))
 State: disabled since September 16, 2015 11:04:39 AM MDT
Reason: Temporarily disabled by an administrator.
```

```
   See: http://Support.coracle.com/msg/SMF-8000-1S
   See: man -M /usr/share/man -s 1M cron
   See: man -M /usr/share/man -s 1 crontab
   See: /var/svc/log/system-cron:default.log
Impact: This service is not running.
...
...
...
```

The `-xvL` option gives sufficient details for you to be able to determine the problem. For additional reference, a URL is listed for a knowledge article on this topic as well as the service log. Because the details tell you the reason, in this case, you can try to enable the service.

5. Enable the `cron` service by using the `svcadm` command. Confirm that the service is back up online.

```
root@s11-desktop:~# svcadm enable cron
root@s11-desktop:~# svcs cron
STATE           STIME    FMRI
online         11:06:14 svc:/system/cron:default
```

Is the `cron` service online? *Yes, it is.*

Practices for Lesson 3: Managing Software Packages by Using IPS

Chapter 3

Practices for Lesson 3: Managing Software Packages by Using IPS

Practices Overview

In this practice, you are presented with a plan for configuring a local IPS package repository by using the Image Packaging System (IPS).

The key area covered in this practice is configuring a local IPS package repository.

Note: Your command output displays may be different from the displays in the practices, especially storage units, process IDs, and related content.

The following checklist shows your progress. Currently, you are about to look into the IPS functionality.

	Oracle Solaris 11 Predeployment Checklist
✓	Managing Services and Service Properties by Using SMF
	Managing Software Packages by Using IPS
	Managing Data Backup and Restore by Using ZFS
	Configuring the Network
	Administering Network Services
	Advanced Administration of Zones
	Securing the Oracle Solaris 11 OS
	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practice 3-1: Configuring a Local IPS Package Repository

Overview

You will recall from the lesson that when you install Oracle Solaris 11 OS, the system initially has one publisher configured: the `solaris` publisher.

In your lab environment, your virtual machine client cannot access the default publisher URL to download the IPS package repository. So, your first task is to create your local package repository and make it the default so that the network client can be serviced by IPS. This involves creating a ZFS file system on the local server for the IPS repository and copying the repository files from the repository ISO image to the local repository.

The package repository is very large. Depending on the speed of your host machine, the `rsync` command can take a couple of hours to complete.

Note: In this practice, IPS repository packages (from the ISO image) have already been copied and installed to the local ZFS file system on S11-Server1 to help you save time.

Task 1: Configuring the Local IPS Repository

Note: Steps of this practice are already performed for you to save time and to speed up the practice. However, the tasks are documented here for your reference and you need to only verify them before proceeding to the next step.

Perform the following steps on S11-Server1 VM:

1. Verify that the S11-Server1 VM is running.

   If it is not running, start it and log in as the `oracle` user. Use the password `oracle1`. Run the `su` command to assume administrator privileges.

```
oracle@s11-server1:~$ su -
Password: oracle1
Oracle Corporation   SunOS 5.11      11.3       September 2015
root@s11-server1:~#
```

2. Determine the host name and domain of this server.

```
root@s11-server1:~# hostname
s11-server1
root@s11-server1:~# domainname
example.com
```

3. Verify that this server can access DNS services.

```
root@s11-server1:~# nslookup s11-server1
Server:   192.168.1.100
Address:  192.168.1.100#53

Name:   s11-server1.example.com
Address:  192.168.1.100
```

4. Verify that the `/var/share/pkg/repositories/Solaris11` file system has been configured on the system.

```
root@s11-server1:~# zpool list
NAME     SIZE  ALLOC   FREE    CAP  DEDUP  HEALTH  ALTROOT
rpool  49.5G  17.5G  32.0G    30%  1.00x  ONLINE  -
root@s11-server1:~# zfs list
NAME                                      USED  AVAIL  REFER  MOUNTPOINT
rpool                                    17.6G  31.1G  4.52M  /rpool
rpool/ROOT                               5.11G  31.1G    31K  legacy
rpool/ROOT/before_lesson02_3Nov           206K  31.1G  4.25G  /
rpool/ROOT/before_lesson02_3Nov/var         1K  31.1G   683M  /var
rpool/ROOT/solaris                       5.11G  31.1G  4.25G  /
rpool/ROOT/solaris/var                    819M  31.1G   683M  /var
rpool/VARSHARE                           9.42G  31.1G  2.45M  /var/share
rpool/VARSHARE/pkg                       9.41G  31.1G    32K  /var/share/pkg
rpool/VARSHARE/pkg/repositories          9.41G  31.1G    32K
/var/share/pkg/repositories
rpool/VARSHARE/pkg/repositories/Solaris11  9.41G  31.1G  9.41G
/var/share/pkg/repositories/Solaris11
rpool/VARSHARE/zones                       31K  31.1G    31K  /system/zones
rpool/dump                               2.06G  31.2G  2.00G  -
rpool/export                              422K  31.1G    34K  /export
rpool/export/home                         358K  31.1G    42K  /export/home
rpool/export/home/asmith                   35K  31.1G    35K  /export/home/asmith
rpool/export/home/jholt                    35K  31.1G    35K  /export/home/jholt
rpool/export/home/oracle                   34K  31.1G    34K  /export/home/oracle
rpool/export/home/panna                  35.5K  31.1G  35.5K  /export/home/panna
rpool/export/home/sstudent                  35.5K  31.1G  35.5K  /export/home/sstudent
rpool/export/zones                         31K  31.1G    31K  /export/zones
rpool/swap                               1.03G  31.1G  1.00G  -
root@s11-server1:~#
```

Note: Your display may be different for space allocation/usage.

Normally, a local IPS repository must be manually created on the local server as you learned in the lesson titled "Managing Software Packages by Using IPS" in this course. This involves creating a ZFS file system on the local server for the IPS repository and copying the repository files from the repository zipped images to the local repository with the help of an installation script.

The package repository is very large (approximately 9.3 gigabytes). Depending on the speed of your host machine, the `install-repo.ksh` script can take an hour to complete.

5. Assess the current IPS configuration on the S11-Server1 system.

   Note: *This task is already performed for you.*

```
root@s11-server1:~# svcs application/pkg/server
STATE     STIME          FMRI
disabled  17:00:56        svc:/application/pkg/server:default
root@s11-server1:~# svcprop -p pkg/inst_root \
application/pkg/server
/var/pkgrepo
```

   This system is not currently configured as an IPS server. (The service is disabled.) Note the default location of the IPS repository as determined by the `pkg/inst_root` property. The `/var/pkgrepo` directory is not the correct location of your local repository.

Note: Steps 6 through 13 are already performed for you.

6. Set the application/pkg/server service pkg/inst_root property to the repository location (/var/share/pkg/repositories/Solaris11).

```
root@s11-server1:~# svccfg –s application/pkg/server setprop \
pkg/inst_root=/var/share/pkg/repositories/Solaris11
root@s11-server1:~#
```

7. Set the application/pkg/server service pkg/readonly property to true.

```
root@s11-server1:~# svccfg –s application/pkg/server setprop \
pkg/readonly=true
```

8. Verify the `application/pkg/server` service `inst_root` property.

```
root@s11-server1:~# svcprop -p pkg/inst_root \
application/pkg/server
/var/share/pkg/repositories/Solaris11
```

9. Refresh the `application/pkg/server` service.

```
root@s11-server1:~# svcadm refresh application/pkg/server
```

10. Enable the `application/pkg/server` service.

```
root@s11-server1:~# svcadm enable application/pkg/server
```

11. Verify that the `application/pkg/server` service is enabled.

```
root@s11-server1:~# svcs application/pkg/server
STATE     STIME     FMRI
online    17:00:56  svc:/application/pkg/server:default
```

12. List the current package publishers.

```
root@s11-server1:~# pkg publisher
PUBLISHER  TYPE    STATUS P LOCATION
solaris    origin  online F http://pkg.oracle.com/solaris/release/
```

The command output shows the current *publisher*. A publisher is a forward domain name that identifies a person, group of persons, or an organization that publishes one or more packages. The repository type *origin* is the location of the package repository that contains both package metadata (package manifests and catalogs) and package content (package files). The default publisher URI is http://pkg.oracle.com/solaris/release/.

13. Remove the current publisher URI (`http://pkg.oracle.com/solaris/release`) and add a new URI (`http://s11-server1.example.com:10000`) to the publisher name `solaris`. Show the results.

```
root@s11-server1:~# pkg set-publisher -G '*' -g \
http://s11-server1.example.com/ solaris
root@s11-server1:~# pkg publisher
PUBLISHER    TYPE    STATUS P LOCATION
solaris    origin   online F http://s11-server1.example.com:10000/
```

14. Test IPS on the local server by searching for the `entire` package.

```
root@s11-server1:~# pkg search entire
INDEX       ACTION VALUE           PACKAGE
...
pkg.fmri    set   solaris/entire  pkg:/entire@0.5.11-
0.175.3.1.0.5.0
```

15. Verify that S11-Desktop VM is running. If not, start it and log in as the `oracle` user and `su` to `root` in a terminal window.
16. Remove the current publisher URI (`http://pkg.oracle.com/solaris/release`) and add a new URI (`http://s11-server1.example.com`) to the publisher name `solaris`.

    Note: *This task is already performed for you.*

```
root@s11-desktop:~# pkg set-publisher –G '*' –g \
http://s11-server1.example.com/ solaris
```

17. Verify that the publisher is set to `http://s11-server1.example.com/`.

```
root@s11-desktop:~# pkg publisher
PUBLISHER   TYPE     STATUS P LOCATION
solaris     origin   online F http://s11-server1.example.com:10000/
```

Task 2: Creating Multiple Local Repositories on a Single System (Demonstration)

Assumptions

Adobe Flash Player is already installed on the host machine before executing the demonstration.

Special note for playing the demonstration in the virtual machine:

- To be able to view demonstration controls in the browser, it is recommended to switch to full screen.
- To switch to full-screen mode in the browser window, go to **View** > **Full Screen**.

Tasks

For this practice, you are provided with a demonstration that will help you understand how to set up multiple repositories on the same machine.

1. On your host machine, open a terminal window.
2. Change to the /opt/ora/demo/Multiple_Repo directory.

```
# cd /opt/ora/demo/Multiple_Repo
# ls
IPS Local Repo.htm   IPS Local Repo.swf  standard.js
```

3. Open the Upgrading System Software Using IPS.htm file in a web browser.

```
# firefox IPS Local Repo.htm &
```

4. A browser window with the Flash demonstration is displayed.
5. Close the web browser after you complete viewing the Flash demonstration.
6. Close the terminal window.

Practices for Lesson 4: Managing Data Back Up and Restore by Using ZFS

Chapter 4

Practice for Lesson 4: Overview

Practices Overview

Following the predeployment test plan, you now need to address the storage requirements of the business applications. The default file system for Oracle Solaris 11 is ZFS. ZFS is the root file system on Oracle Solaris 11 that offers a superior experience in terms of manageability, scalability, and data integrity.

You need to configure multiple ZFS storage pools. In this case, your organization is working with the Oracle CRM application, for which you will need to create file systems for storing business application data. It is important to ensure that the company's critical application data is protected, backed up regularly, and easily recoverable. At the same time, it is important to ensure that data remains highly accessible to its users. Moreover, where possible, you need to focus on minimizing data storage space requirements by:

- Providing data redundancy by using mirrored storage pools
- Setting up file systems to store the data
- Backing up the file systems that store the data by using ZFS snapshot technology
- Minimizing the amount of file system space that is needed to store the data by using the ZFS compression property

The key areas explored in this practice are:

- Managing data redundancy with a ZFS mirrored pool
- Using ZFS snapshots for backup and recovery
- Configuring ZFS properties
- Troubleshooting ZFS failures

Note: Your command output displays can be different from the displays in the practice, especially storage, process IDs, and other information.

Look at your checklist to see where you are.

	Oracle Solaris 11 Predeployment Checklist
✓	Managing Services and Service Properties by Using SMF
✓	Managing Software Packages by Using IPS
	Managing Data Backup and Restore by Using ZFS
	Configuring the Network
	Administering Network Services
	Advanced Administration of Zones
	Securing the Oracle Solaris 11 OS
	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practice 4-1: Managing Data Redundancy with a ZFS Mirrored Pool

Overview

In this practice, you test application data redundancy by using different scenarios. First you create a ZFS mirrored pool that contains one mirror. To minimize the chances of losing data, you distribute the data over two mirrors. At this time, to address a policy change, you reconfigure the pool to keep three copies of data, which requires you to create a three-way mirror.

Tasks

1. Verify whether S11-Desktop and S11-Server1 VMs are running.
   If they are not running, start them now. Log in as the `oracle` user with `oracle1` as the password. Assume administrator privileges. Continue working on the S11-Desktop VM.
2. Close any open terminal windows and open a new terminal window.
3. Execute the `zpool list` command to display the ZFS pools that are currently configured in the system.

```
root@s11-desktop:~# zpool list
NAME    SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
rpool  15.6G  8.58G  7.04G  54%  1.00x  ONLINE  -
```

   Currently, the only ZFS pool that is available is the root pool, which is needed to make the ZFS file system a root file system.

   Note: The output may vary from system to system.

4. Use the `zpool status` command to determine the disks that are currently configured for the ZFS `rpool`.

```
root@s11-desktop:~# zpool status rpool
  pool: rpool
 state: ONLINE
 scan: none requested
config:

    NAME        STATE     READ WRITE CKSUM
    rpool       ONLINE       0     0     0
      c2t0d0    ONLINE       0     0     0

errors: No known data errors
```

   This display shows that `rpool` is using the local disk `c2t0d0`.
   Therefore, when creating new pools, leave this disk untouched.

5. Execute the `format` command to identify any additional disks configured in the system.

```
root@s11-desktop:~# format
Searching for disks...done


AVAILABLE DISK SELECTIONS:
       0. c2t0d0 <Unknown-Unknown-0001-16.00GB>
          /xpvd/xdf@51712
       1. c2t2d0 <Unknown-Unknown-0001-2.00GB>
          /xpvd/xdf@51744
       2. c2t3d0 <Unknown-Unknown-0001-2.00GB>
          /xpvd/xdf@51760
       3. c2t4d0 <Unknown-Unknown-0001 cyl 1024 alt 0 hd 128 sec 32>
          /xpvd/xdf@51776
       4. c2t5d0 <Unknown-Unknown-0001 cyl 1024 alt 0 hd 128 sec 32>
          /xpvd/xdf@51792
       5. c2t6d0 <Unknown-Unknown-0001 cyl 1024 alt 0 hd 128 sec 32>
          /xpvd/xdf@51808
Specify disk (enter its number): ^C
```

The display tells you that disks `c2t2d0` to `c2t6d0` are available for use.

To cancel the `format` command, press Ctrl + C or Ctrl + D.

6. Create a mirrored ZFS pool named `oraclecrm` by using disks `c2t2d0` and `c2t3d0`. Show the results.

```
root@s11-desktop:~# zpool create oraclecrm mirror c2t2d0 c2t3d0
root@s11-desktop:~# zpool list
NAME         SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
oraclecrm   1.98G   112K  1.98G   0%  1.00x  ONLINE  -
rpool       15.6G  8.65G  6.97G  55%  1.00x  ONLINE  -
root@s11-desktop:~#
```

Here, you created a pool called `oraclecrm` with a mirror by using two free disks. The purpose of this pool is to store the Oracle business application Customer Relationship Management (CRM) components. Because your company required redundancy, you have created a mirror, which means that you have an online copy of the CRM data. This online copy will come in handy in case one of the disks gets corrupted.

7. Add another mirror in the `oraclecrm` pool by using disks `c2t4d0` and `c2t5d0`.

```
root@s11-desktop:~# zpool add oraclecrm mirror c2t4d0 c2t5d0
root@s11-desktop:~# zpool status oraclecrm
  pool: oraclecrm
 state: ONLINE
  scan: none requested
config:

        NAME        STATE     READ WRITE CKSUM
        oraclecrm   ONLINE       0     0     0
          mirror-0  ONLINE       0     0     0
            c2t2d0  ONLINE       0     0     0
            c2t3d0  ONLINE       0     0     0
          mirror-1  ONLINE       0     0     0
            c2t4d0  ONLINE       0     0     0
            c2t5d0  ONLINE       0     0     0

errors: No known data errors
```

Your company is very concerned about losing data because of data or disk corruption. You are asked to spread the data over multiple disks to mitigate the risk of data loss. To satisfy this objective, you create another mirror by using two free disks. Now, the data is distributed over the two mirrors and the respective disks. This means that 50% of the data will be stored in the first mirror and 50% of the data in the second mirror. You will see a demonstration subsequently.

8. Check the capacity of both the mirrors by issuing the `zpool iostat -v oraclecrm` command.

```
root@s11-desktop:~# zpool iostat -v oraclecrm
               capacity     operations    bandwidth
pool        alloc   free   read  write   read  write
----------  -----  -----  -----  -----  -----  -----
oraclecrm     91K  3.97G      0     10    110  10.4K
  mirror-0    78K  1.98G      0      8    110  9.01K
    c2t2d0      -      -      0      7  5.17K  38.1K
    c2t3d0      -      -      0      7  5.06K  38.1K
  mirror-1    13K  1.98G      0      2      0  2.66K
    c2t4d0      -      -      0      3  7.85K  62.2K
    c2t5d0      -      -      0      3  7.85K  62.2K
----------  -----  -----  -----  -----  -----  -----
```

Note: Output varies from system to system.

Here you see the two mirrors listed with their details. Note that the total free space in the pool, 3.97 GB, has been equally distributed between the two mirrors (1.98 GB and 1.98 GB, respectively). The `alloc` column shows the ZFS overhead.

9. Determine the mount point of the top-level file system.

```
root@s11-desktop:~# zfs list oraclecrm
NAME         USED  AVAIL  REFER  MOUNTPOINT
oraclecrm     91K  3.91G    31K  /oraclecrm
```

The mount point of the pool or the top-level file system of `oraclecrm` is `/oraclecrm`. This is the root of the pool; that is, all the file systems that are created will be within this mount point.

10. Create a 2 MB file by using the `mkfile` command. Check the file storage allocation for the mirrors by running the `zpool iostat` command.

```
root@s11-desktop:~# mkfile 2m /oraclecrm/crmindex
root@s11-desktop:~# zpool iostat -v oraclecrm
               capacity     operations    bandwidth
pool         alloc   free   read  write   read  write
----------  -----  -----  -----  -----  -----  -----
oraclecrm   2.13M  3.97G      0      5     56  13.0K
  mirror-0  1.10M  1.98G      0      4     56  8.43K
    c2t2d0      -      -      0      4  2.58K  23.0K
    c2t3d0      -      -      0      4  2.52K  23.0K
  mirror-1  1.03M  1.98G      0      1      0  5.98K
    c2t4d0      -      -      0      1  2.74K  26.7K
    c2t5d0      -      -      0      1  2.74K  26.7K
----------  -----  -----  -----  -----  -----  -----
root@s11-desktop:~#
```

Note: Your display may show different numbers.

Your CRM analyst shared with you that a small file will be needed for storing the index of the CRM application. You create a 2 MB file called `crmindex` in the pool.

Note how this 2 MB worth of storage has been roughly divided between the two mirrors. This shows that all CRM data will be divided between the two mirrors.

Hint: In some cases, it may help to wait for some time before issuing the `zpool iostat` command to allow ZFS to complete writing to the mirrors.

11. Use the `zfs list` command to list the capacity summary for the `oraclecrm` pool.

```
root@s11-desktop:~# zfs list oraclecrm
NAME         USED  AVAIL  REFER  MOUNTPOINT
oraclecrm   2.09M  3.90G  2.03M  /oraclecrm
```

Note the space used now at the top-level file system. This reflects the 2 MB of storage used by the `crmindex` file.

12. Use the `zpool destroy` command to delete the pool. Confirm the deletion by using the `zpool list` command.

```
root@s11-desktop:~# zpool destroy oraclecrm
root@s11-desktop:~# zpool list oraclecrm
```

```
cannot open 'oraclecrm': no such pool
```

Based on a review by the CRM analyst, there was a change in direction. It was agreed that you keep three copies of data and not distribute it over two separate mirror sets.

To address this objective, you delete the current data redundancy configuration and destroy the pool to create the new configuration.

13. Re-create the mirrored ZFS pool named `oraclecrm` by using the disks `c2t2d0` and `c2t3d0`. Show the results.

```
root@s11-desktop:~# zpool create oraclecrm mirror c2t2d0 c2t3d0
root@s11-desktop:~# zpool list
NAME         SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
oraclecrm   1.98G   126K  1.98G   0%  1.00x  ONLINE  -
rpool       15.6G  8.65G  6.97G  55%  1.00x  ONLINE  -
```

Note: The purpose of the reconfiguration is to create a three-way mirror now and reuse the existing storage disks. This will also assist you in focusing on a cleaner setup, for instance, having one mirror.

14. Use the `zpool attach` command to add another disk to the mirror to make it a three-way mirror. Confirm this action by using the `zpool status` command.

```
root@s11-desktop:~# zpool attach oraclecrm c2t2d0 c2t4d0
root@s11-desktop:~# zpool status oraclecrm
  pool: oraclecrm
 state: ONLINE
  scan: resilvered 64K in 1s with 0 errors on Sep 21 23:48:32
2015
config:

        NAME         STATE     READ WRITE CKSUM
        oraclecrm    ONLINE       0     0     0
          mirror-0   ONLINE       0     0     0
            c2t2d0   ONLINE       0     0     0
            c2t3d0   ONLINE       0     0     0
            c2t4d0   ONLINE       0     0     0

errors: No known data errors
```

Now this new configuration meets the objective of maintaining redundancy by keeping three copies of data on three individual disks. The application data can be created as shown earlier.

Notice that the `attach` command specifies an existing disk in the mirror and a free disk to be included in the mirror. The result is displayed by the `status` command. The `status` display also shows the resilvering action. The purpose of resilvering is to replicate data on the newly added disk.

15. Use the `zpool add` command to add a cache device to the mirror to allow the cache device to be used as local pool memory. Confirm this action by using the `zpool status` command.

```
root@s11-desktop:~# zpool add oraclecrm cache c2t5d0
root@s11-desktop:~# zpool status oraclecrm
  pool: oraclecrm
 state: ONLINE
  scan: resilvered 64K in 0h0m with 0 errors on Mon Sep 21
23:48:32 2015
config:
        NAME         STATE     READ WRITE CKSUM
        oraclecrm    ONLINE       0     0     0
          mirror-0   ONLINE       0     0     0
            c2t2d0   ONLINE       0     0     0
            c2t3d0   ONLINE       0     0     0
            c2t4d0   ONLINE       0     0     0
        cache
           c2t5d0     ONLINE       0     0     0

errors: No known data errors
```

This added device will serve as local memory for the pool to boost the input/output performance. Your business analyst had indicated that you may need to boost the I/O performance of the pool.

16. Your business analyst has now indicated that you do not need to boost pool performance because of the low volume of data. Use the `zpool remove` command to delete the cache device. Confirm this action by using the `zpool status` command.

```
root@s11-desktop:~# zpool remove oraclecrm c2t5d0
root@s11-desktop:~# zpool status oraclecrm
  pool: oraclecrm
 state: ONLINE
  scan: resilvered 64K in 0h0m with 0 errors on Mon Sep 21
23:48:32 2015
config:

        NAME         STATE     READ WRITE CKSUM
        oraclecrm    ONLINE       0     0     0
          mirror-0   ONLINE       0     0     0
            c2t2d0   ONLINE       0     0     0
            c2t3d0   ONLINE       0     0     0
            c2t4d0   ONLINE       0     0     0

errors: No known data errors
```

Note that the cache device does not appear in the display.

```
root@s11-desktop:~# zpool list
NAME        SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
oraclecrm  1.98G   102K  1.98G   0%  1.00x  ONLINE  -
rpool      15.6G  8.65G  6.97G  55%  1.00x  ONLINE  -
```

17. Use the `zpool destroy` command to delete the pool. Use the `zpool list` command to confirm the deletion.

```
root@s11-desktop:~# zpool destroy oraclecrm
root@s11-desktop:~# zpool list
NAME   SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
rpool  15.6G  8.65G  6.97G  55%  1.00x  ONLINE  -
```

In the next practice, you will create a new pool with no mirrors to simplify working with ZFS backup and recovery functions.

Practice 4-2: Using ZFS Snapshots for Backup and Recovery

Overview

According to your predeployment test plan, in this practice, you evaluate the data backup and recovery mechanism in Oracle Solaris 11. For backing up the data, you create snapshots, as well as use ZFS send/receive commands. The send/receive commands can be used to save the backed up data (snapshots) on the local or remote machine. You use rollback commands to recover the backed up or lost data.

Tasks

1. Verify that S11-Desktop and S11-Server1 VMs are running.
2. Execute the `zpool list` command to display the ZFS pools that are currently configured in the system.

```
root@s11-desktop:~# zpool list
NAME        SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
rpool      15.6G  8.65G  7.97G  55%  1.00x  ONLINE  -
```

3. Run the `zpool create` command to create a pool with two top-level virtual devices. Check the pool information by using `zpool list` and `zpool status`.

```
root@s11-desktop:~# zpool create oraclecrm c2t3d0 c2t4d0
'oraclecrm' successfully created, but with no redundancy;
failure of one device will cause loss of the pool
root@s11-desktop:~# zpool list
NAME        SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
oraclecrm  3.97G   125K  3.97G   0%  1.00x  ONLINE  -
rpool      15.6G  8.65G  6.97G  55%  1.00x  ONLINE  -
```

You now create a fresh pool by using two disks. This will give you experience in creating a simple pool without any mirror. Because your configuration is simple, your displays will be clean and easy to follow.

Confirm that the new pool has been created.

```
root@s11-desktop:~# zpool status oraclecrm
  pool: oraclecrm
 state: ONLINE
  scan: none requested
config:

        NAME       STATE     READ WRITE CKSUM
        oraclecrm  ONLINE       0     0     0
           c2t3d0  ONLINE       0     0     0
           c2t4d0  ONLINE       0     0     0

errors: No known data errors
```

4. Create a file system named `oraclecrm/crmdata` with a mount point of `/crmdata`. Check the file system creation and the mount point by running the `zfs list` command.

```
root@s11-desktop:~# zfs create –o mountpoint=/crmdata \
oraclecrm/crmdata
root@s11-desktop:~# zfs list -r oraclecrm
NAME                USED  AVAIL  REFER  MOUNTPOINT
oraclecrm           136K  3.91G    31K  /oraclecrm
oraclecrm/crmdata    31K  3.91G    31K  /crmdata
```

You create a file system called `crmdata` in the `oraclecrm` pool. In this file system, you plan to store data in various CRM applications, such as Order Management, Marketing, and Customers.

Note that the mount point was specified to be `/crmdata` for `oraclecrm/crmdata` to be able to access the `crmdata` file system directly.

5. Create new ZFS file systems named `oraclecrm/crmdata/cust`, `oraclecrm/crmdata/mktg`, and `oraclecrm/crmdata/om`. List the descendants of the `oraclecrm` file system.

```
root@s11-desktop:~# zfs create oraclecrm/crmdata/cust
root@s11-desktop:~# zfs create oraclecrm/crmdata/mktg
root@s11-desktop:~# zfs create oraclecrm/crmdata/om
root@s11-desktop:~# zfs list -r oraclecrm
NAME                     USED  AVAIL  REFER  MOUNTPOINT
oraclecrm                255K  3.91G    31K  /oraclecrm
oraclecrm/crmdata        128K  3.91G    35K  /crmdata
oraclecrm/crmdata/cust    31K  3.91G    31K  /crmdata/cust
oraclecrm/crmdata/mktg    31K  3.91G    31K  /crmdata/mktg
oraclecrm/crmdata/om      31K  3.91G    31K  /crmdata/om
```

Note: These file systems are created to demonstrate individual file systems for each business application, as you will experience on the job.

Here, you create file systems to store data for the CRM application. The file systems are `cust`, `mktg`, and `om`. Note the `used` column and the `refer` column for the new file systems. The file systems are consuming an initial storage space of 31 KB.

6. Using the `tar` command, create a tar bundle that will serve as an example of the business application data. Copy `custarchive.tar` to each `crmdata` file system and the `/opt/ora/data` directory for future use. Note the amount of data used and referenced by these file systems.

```
root@s11-desktop:~# tar cvf /crmdata/cust/custarchive.tar \
/usr/demo
a /usr/demo/ 0K
a /usr/demo/jds/ 0K
a /usr/demo/jds/bin 0K
a /usr/demo/jds/bin/lou_translate 24K

…
…
…
(output truncated)

root@s11-desktop:~# cp /crmdata/cust/custarchive.tar \
/crmdata/mktg/custarchive.tar
root@s11-desktop:~# cp /crmdata/cust/custarchive.tar \
/crmdata/om/custarchive.tar
```

Save the data in `/opt/ora/data` so that it will be available to you in subsequent steps.

```
root@s11-desktop:~# mkdir –p /opt/ora/data
root@s11-desktop:~# cp /crmdata/cust/custarchive.tar \
/opt/ora/data/custarchive.tar
```

For training purposes, you are creating application data and placing it in the `crmdata` file systems.

```
root@s11-desktop:~# zfs list -r oraclecrm
NAME                        USED  AVAIL  REFER  MOUNTPOINT
oraclecrm                  9.42M  3.90G    31K  /oraclecrm
oraclecrm/crmdata          9.14M  3.90G    35K  /crmdata
oraclecrm/crmdata/cust     3.03M  3.90G  3.03M  /crmdata/cust
oraclecrm/crmdata/mktg     3.03M  3.90G  3.03M  /crmdata/mktg
oraclecrm/crmdata/om       3.03M  3.90G  3.03M  /crmdata/om
```

After placing application data in each file system, you see that all the file systems indicate 3.03 MB worth of storage. Your numbers can be different.

7. Create a recursive snapshot of `oraclecrm/crmdata` named `oraclecrm/crmdata@Monday`. List the file systems below `oraclecrm`. Note the amount of space used and referenced by `oraclecrm/crmdata@Monday`.

```
root@s11-desktop:~# zfs snapshot -r oraclecrm/crmdata@Monday
```

Recursively create snapshots of every file system in `crmdata`. The purpose is to create a backup of each file system—that is, `cust`, `mktg`, and `om` data.

```
root@s11-desktop:~# zfs list -r oraclecrm
NAME                     USED  AVAIL  REFER  MOUNTPOINT
oraclecrm               9.27M  3.90G    31K  /oraclecrm
oraclecrm/crmdata       9.14M  3.90G    35K  /crmdata
oraclecrm/crmdata/cust  3.03M  3.90G  3.03M  /crmdata/cust
oraclecrm/crmdata/mktg  3.03M  3.90G  3.03M  /crmdata/mktg
oraclecrm/crmdata/om    3.03M  3.90G  3.03M  /crmdata/om
```

Now, when you try to display the children file systems of `oraclecrm` recursively, the snapshots are not displayed. Take a look at this.

```
root@s11-desktop:~# zpool get listsnapshots oraclecrm
NAME       PROPERTY       VALUE      SOURCE
oraclecrm  listsnapshots  off        default
```

As displayed here, the `listsnapshots` property is `off` by default. You now enable it.

```
root@s11-desktop:~# zpool set listsnapshots=on oraclecrm
```

Now, when you display the descendant file systems of `oraclecrm`, they are displayed. Note that there is one snapshot for each file system and they are all suffixed with `@Monday`. As you can see, this is a very easy way to create multiple data backups and identify all of them with the same identifier.

```
root@s11-desktop:~# zfs list -r oraclecrm
NAME                            USED  AVAIL  REFER  MOUNTPOINT
NAME                            USED  AVAIL  REFER  MOUNTPOINT
oraclecrm                      9.43M  3.90G    31K  /oraclecrm
oraclecrm/crmdata              9.14M  3.90G    35K  /crmdata
oraclecrm/crmdata@MOnday           0      -    35K  -
oraclecrm/crmdata/cust         3.03M  3.90G  3.03M  /crmdata/cust
oraclecrm/crmdata/cust@MOnday      0      -  3.03M  -
oraclecrm/crmdata/mktg         3.03M  3.90G  3.03M  /crmdata/mktg
oraclecrm/crmdata/mktg@MOnday      0      -  3.03M  -
oraclecrm/crmdata/om           3.03M  3.90G  3.03M  /crmdata/om
oraclecrm/crmdata/om@MOnday        0      -  3.03M  -
```

Note that the newly created snapshots do not use any space (initially) but they do indicate 3.03 MB worth of storage, which includes the data that you placed in each file system. The snapshots initially do not take up any space because they are using the existing file system data pointers.

8. Create a file named `/crmdata/cust/colochoc`. Confirm that the file exists.

```
root@s11-desktop:~# touch /crmdata/cust/colochoc
```

You create a file to store data on a customer `colochoc` (for Colorado Chocolate Company).

```
root@s11-desktop:~# ls /crmdata/cust/colochoc
/crmdata/cust/colochoc
```

Success! You confirmed that it exists. Note that this file was created after taking a backup on Monday.

9. Create another recursive snapshot named `oraclecrm/crmdata@Tuesday`.

```
root@s11-desktop:~# zfs snapshot -r oraclecrm/crmdata@Tuesday
```

Note that the `colochoc` file will be included in the Tuesday snapshot but not in the Monday snapshot.

Review ZFS Snapshot Differences Recursively

10. Display the ZFS snapshots differences within the descendent file system by using the `zfs diff` command.

```
root@s11-desktop:~# zfs diff -r oraclecrm/crmdata@Monday \
oraclecrm/crmdata@Tuesday
D    /crmdata/cust/   (oraclecrm/crmdata/cust)
+    /crmdata/cust/colochoc
```

In the output, the plus (`+`) sign indicates an entry in the given file system and **`D`** indicates an existing file system.

Note: Here, one snapshot is compared with another snapshot. You can see that the `/crmdata/cust/colochoc` file is added to the second snapshot.

11. Attempt to roll back the `oraclecrm/crmdata` snapshot by using the `oraclecrm/crmdata@Monday` snapshot. What happens?

```
root@s11-desktop:~# zfs rollback oraclecrm/crmdata@Monday
cannot rollback to 'oraclecrm/crmdata@Monday': more recent
snapshots exist
use '-r' to force deletion of the following snapshots:
oraclecrm/crmdata@Tuesday
```

Notice that more recent snapshots (`crmdata@Tuesday`) exist; therefore, you cannot roll back to an earlier snapshot unless you use the `-r` option that deletes the more recent snapshots until the `crmdata@Monday` snapshot becomes the most recent. Do not roll back yet.

Question: If the `oraclecrm/crmdata` snapshot is rolled back to the Monday snapshot, what data will be lost?

Answer: The file named `/crmdata/cust/colochoc` will be lost.

12. Delete the file named `/crmdata/cust/colochoc`.

```
root@s11-desktop:~# cd /crmdata/cust
root@s11-desktop:/crmdata/cust# rm colochoc
root@s11-desktop:/crmdata/cust# cd
root@s11-desktop:~#
```

Remove the customer `colochoc` to see if you can recover it.

13. List the descendant `oraclecrm` file systems. Roll back the `oraclecrm/crmdata/cust@Tuesday` snapshot.

```
root@s11-desktop:~# zfs list -r oraclecrm
NAME                              USED  AVAIL  REFER  MOUNTPOINT
oraclecrm                        9.35M  3.90G    31K  /oraclecrm
oraclecrm/crmdata                9.17M  3.90G    35K  /crmdata
oraclecrm/crmdata@MOnday             0      -    35K  -
oraclecrm/crmdata@Tuesday            0      -    35K  -
oraclecrm/crmdata/cust           3.07M  3.90G  3.03M  /crmdata/cust
oraclecrm/crmdata/cust@MOnday      19K      -  3.03M  -
oraclecrm/crmdata/cust@Tuesday     19K      -  3.03M  -
oraclecrm/crmdata/mktg           3.03M  3.90G  3.03M  /crmdata/mktg
oraclecrm/crmdata/mktg@MOnday        0      -  3.03M  -
oraclecrm/crmdata/mktg@Tuesday       0      -  3.03M  -
oraclecrm/crmdata/om             3.03M  3.90G  3.03M  /crmdata/om
oraclecrm/crmdata/om@MOnday          0      -  3.03M  -
oraclecrm/crmdata/om@Tuesday         0      -  3.03M  -

root@s11-desktop:~# zfs rollback oraclecrm/crmdata/cust@Tuesday
```

You rolled back (recovered) to the `cust@Tuesday` backup. Does it include the `colochoc` customer file? You will find out in the next step.

14. Confirm that `/crmdata/cust/colochoc` is restored.

```
root@s11-desktop:~# ls /crmdata/cust/colochoc
/crmdata/cust/colochoc
```

Yes, your customer `colochoc` is restored. Because the Tuesday backup was taken after you created this customer, it was in your `cust@tuesday` backup.

15. Create a directory named `/backup`.

```
root@s11-desktop:~# mkdir /backup
```

Create a separate directory to store your Monday backups. Your company wants to save these backups offsite because this is the end of the quarter for your company.

16. Use the `zfs send` command to recursively send the `oraclecrm/crmdata@Monday` snapshot. Save the copy in a file named `/backup/oraclecrm.crmdata.Monday`.

```
root@s11-desktop:~# zfs send -Rv oraclecrm/crmdata@Monday > \
/backup/oraclecrm.crmdata.Monday
sending full stream to oraclecrm/crmdata@Monday
sending full stream to oraclecrm/crmdata/om@Monday
sending full stream to oraclecrm/crmdata/mktg@Monday
sending full stream to oraclecrm/crmdata/cust@Monday
estimated stream size: 9.09M
```

Now you have only one `/backup` directory, which contains all the Monday backups. This directory can be archived on tape or sent to another machine on the network. See how simple the command is. Use `-R` to send all the snapshots in `crmdata@monday`. The backed-up snapshot naming convention has changed slightly to enable differentiation between the snapshots and the backed-up data.

17. Use the `ls -lh` command to list the size of the file in `/backup`. Verify that it approximately matches the size of the space used by the `oraclecrm/crmdata` file systems.

```
root@s11-desktop:~# ls -lh /backup
total 18959
-rw-r--r--   1 root     root        9.2M Sep 21 01:11
oraclecrm.crmdata.Monday
root@s11-desktop:~# zfs list /crmdata
NAME                 USED  AVAIL  REFER  MOUNTPOINT
oraclecrm/crmdata  9.16M  3.93G    34K  /crmdata
```

Yes. It does match approximately.

18. Use the `zfs send` command to send the `oraclecrm/crmdata/cust@Monday` snapshot to the `/backup` directory. Then list the size of the snapshot stream.

```
root@s11-desktop:~# zfs send oraclecrm/crmdata/cust@Monday > \
/backup/oraclecrm.crmdata.cust.Monday
root@s11-desktop:~# ls -lh /backup/oraclecrm.crmdata.cust.Monday
-rw-r--r--   1 root     root        3.1M Sep 21 01:13
/backup/oraclecrm.crmdata.cust.Monday
root@s11-desktop:~# zfs list -r oraclecrm
NAME                             USED  AVAIL  REFER  MOUNTPOINT
oraclecrm                       9.35M  3.90G    31K  /oraclecrm
oraclecrm/crmdata               9.16M  3.90G    35K  /crmdata
oraclecrm/crmdata@Monday            0      -    35K  -
oraclecrm/crmdata@Tuesday           0      -    35K  -
oraclecrm/crmdata/cust          3.05M  3.90G  3.03M  /crmdata/cust
oraclecrm/crmdata/cust@Monday     19K      -  3.03M  -
oraclecrm/crmdata/cust@Tuesday     1K      -  3.03M  -
oraclecrm/crmdata/mktg          3.03M  3.90G  3.03M  /crmdata/mktg
oraclecrm/crmdata/mktg@Monday       0      -  3.03M  -
oraclecrm/crmdata/mktg@Tuesday      0      -  3.03M  -
oraclecrm/crmdata/om            3.03M  3.90G  3.03M  /crmdata/om
oraclecrm/crmdata/om@Monday         0      -  3.03M  -
oraclecrm/crmdata/om@Tuesday        0      -  3.03M  -
```

As you can see, the Monday snapshot for the `cust` file system and its Monday backup file consume approximately the same amount of storage space.

19. Destroy the `oraclecrm/crmdata/cust` file system. Confirm whether it is deleted.

```
root@s11-desktop:~# zfs destroy -r oraclecrm/crmdata/cust
root@s11-desktop:~# zfs list /crmdata/cust
/crmdata/cust: No such file or directory
```

You are destroying the `cust` file system so that you can test the recover (`receive`) function.

20. Use the `zfs receive` command to re-create the `oraclecrm/crmdata/cust` file system. Confirm the file system recovery by using the `zfs list` command.

```
root@s11-desktop:~# zfs receive oraclecrm/crmdata/cust < \
/backup/oraclecrm.crmdata.cust.Monday
root@s11-desktop:~# zfs list /crmdata/cust
NAME                    USED  AVAIL  REFER  MOUNTPOINT
oraclecrm/crmdata/cust  3.03M  3.93G  3.03M /crmdata/cust
```

This demonstrates that the recovery was successful.

21. Use the `zfs list` command to confirm the recovery of the full `/crmdata/cust` file system.

```
root@s11-desktop:~# zfs list -r oraclecrm
NAME                              USED  AVAIL  REFER  MOUNTPOINT
oraclecrm                        9.34M  3.90G    31K  /oraclecrm
oraclecrm/crmdata                9.16M  3.90G    35K  /crmdata
oraclecrm/crmdata@Monday             0      -    34K  -
oraclecrm/crmdata@Tuesday            0      -    34K  -
oraclecrm/crmdata/cust           3.03M  3.90G  3.03M  /crmdata/cust
oraclecrm/crmdata/cust@Monday        0      -  3.03M  -
oraclecrm/crmdata/mktg           3.03M  3.90G  3.03M  /crmdata/mktg
oraclecrm/crmdata/mktg@Monday        0      -  3.03M  -
oraclecrm/crmdata/mktg@Tuesday       0      -  3.03M  -
oraclecrm/crmdata/om             3.03M  3.90G  3.03M  /crmdata/om
oraclecrm/crmdata/om@Monday          0      -  3.03M  -
oraclecrm/crmdata/om@Tuesday         0      -  3.03M  -
```

This concludes the backup and recovery exercise.

Delete the `oraclecrm` pool and its descendant file systems. You will create new file systems in the next practice.

```
root@s11-desktop:~# zpool destroy oraclecrm
root@s11-desktop:~# zpool list
NAME   SIZE   ALLOC  FREE   CAP  DEDUP  HEALTH  ALTROOT
rpool  39.5G  7.12G  32.4G  18%  1.00x  ONLINE  -
```

Practice 4-3: Configuring ZFS Properties

Overview

According to your predeployment test plan, in this practice, you check to see how share, quotas and reservation, and data compression techniques work in Oracle Solaris 11.

While working with the quota and reservation properties, you create a new user, make the home directory a ZFS file system, and set the properties on the user's file system.

In this practice, you will perform the following activities:

- Configure the `quota` property.
- Configure the `reservation` property.
- Configure the `share` property.
- Configure `ZFS` compression.

Task 1: Configure the `quota` Property

1. Verify that the S11-Desktop and S11-Server1 VMs are running.
2. Run the `zpool list` command to check the pools available. Use `zfs list` to display the file systems available.

```
root@s11-desktop:~# zpool list
NAME        SIZE   ALLOC   FREE   CAP  DEDUP  HEALTH  ALTROOT
rpool       39.5G  7.08G  32.4G  17%  1.00x  ONLINE  -

root@s11-desktop:~# zfs list
NAME                              USED  AVAIL  REFER  MOUNTPOINT
rpool                            7.17G  31.7G  4.97M  /rpool
rpool/ROOT                       5.10G  31.7G    31K  legacy
rpool/ROOT/solaris               4.94G  31.7G  4.27G  /
rpool/ROOT/solaris/var            415M  31.7G   205M  /var
rpool/VARSHARE                    152K  31.7G  57.5K  /var/share
rpool/VARSHARE/pkg                 63K  31.7G    32K  /var/share/pkg
rpool/VARSHARE/pkg/repositories    31K  31.7G    31K
/var/share/pkg/repositories
rpool/VARSHARE/zones               31K  31.7G    31K  /system/zones
rpool/dump                       1.03G  31.8G  1.00G  -
rpool/export                     1.15M  31.7G    32K  /export
rpool/export/home                1.12M  31.7G    37K  /export/home
rpool/export/home/jholt            35K  31.7G    35K
/export/home/jholt
rpool/export/home/jmoose           35K  31.7G    35K
/export/home/jmoose
rpool/export/home/oracle          963K  31.7G   963K
/export/home/oracle
rpool/export/home/panna            35K  31.7G    35K
/export/home/panna
rpool/export/home/sstudent         41K  31.7G    41K
/export/home/sstudent
```

```
rpool/swap                         1.03G  31.8G  1.00G  -
```

Note that the `/export/home` file system is designed to store the file systems that become the home directories for users.

3. Now you can create the new user `gail` and use the ZFS file system as Gail's home directory.

```
root@s11-desktop:~# useradd -u 60015 -g 10 -d /export/home/gail -m gail
80 blocks
root@s11-desktop:~# ls -ld /export/home/gail
drwxr-xr-x   2 gail     staff   7 Sep 21 01:27 /export/home/gail
```

4. Set a storage quota of 2 MB for Gail.

```
root@s11-desktop:~# zfs get quota rpool/export/home/gail
NAME                    PROPERTY  VALUE  SOURCE
rpool/export/home/gail  quota     none   local
root@s11-desktop:~# zfs set quota=2M rpool/export/home/gail
root@s11-desktop:~# zfs get quota rpool/export/home/gail
NAME                    PROPERTY  VALUE  SOURCE
rpool/export/home/gail  quota     2M     local

root@s11-desktop:~# zfs list /export/home/gail
NAME                    USED  AVAIL  REFER  MOUNTPOINT
rpool/export/home/gail   35K  1.97M    35K  /export/home/gail

root@s11-desktop:~# df -h /export/home/gail
Filesystem             Size  Used Available Capacity  Mounted on
rpool/export/home/gail
                       2.0M   35K     2.0M       2%  /export/home/gail
```

Note the available space for Gail as displayed by multiple commands.

5. Switch to Gail's account and create a few files to test the storage limit.

```
root@s11-desktop:~# su - gail
Oracle Corporation      SunOS 5.11     11.3      Aug 2015
gail@s11-desktop:~$ mkfile 1m /export/home/gail/crmindex
gail@s11-desktop:~$ ls -l /export/home/gail/crmindex
-rw-------   1 gail     staff    1048576 Sep 21 01:31
/export/home/gail/crmindex
```

You needed to create a 1 MB file to store the CRM index information. Because Gail is within her storage quota, there are no issues.

6. Create more files in Gail's account to test the storage limit.

```
gail@s11-desktop:~$ mkfile 2m /export/home/gail/crmdoc
```

Here you have only 1 MB left in the quota. The system allocated the requested amount but initialized only enough storage to meet the quota. It could spell potential problems if you use up all the allocated space.

```
gail@s11-desktop:~$ ls -l /export/home/gail
total 4112
-rw-------   1 gail     staff    2097152 Sep 21 01:32 crmdoc
-rw-------   1 gail     staff    1048576 Sep 21 01:31 crmindex
-rw-r--r--   1 gail     staff        166 Sep 21 01:27 local.cshrc
-rw-r--r--   1 gail     staff        170 Sep 21 01:27 local.login
-rw-r--r--   1 gail     staff        131 Sep 21 01:27 local.profile
gail@s11-desktop:~$ mkfile 2m /export/home/gail/crmreq
Could not open /export/home/gail/crmreq: Disc quota exceeded
```

This is as expected.

```
gail@s11-desktop:~$ ls -l /export/home/gail
total 4112
-rw-------   1 gail     staff    2097152 Sep 21 01:32 crmdoc
-rw-------   1 gail     staff    1048576 Sep 21 01:31 crmindex
-rw-r--r--   1 gail     staff        166 Sep 21 01:27 local.cshrc
-rw-r--r--   1 gail     staff        170 Sep 21 01:27 local.login
-rw-r--r--   1 gail     staff        131 Sep 21 01:27 local.profile
gail@s11-desktop:~$ exit
logout
root@s11-desktop:~#
```

Task 2: Configure the `reservation` Property

1. Gail is now working on a different project and needs to reserve 10 MB of storage. So now, as an administrator, you want to make a storage reservation for Gail.

```
root@s11-desktop:~# zfs set reservation=10M \
rpool/export/home/gail
cannot set property for 'rpool/export/home/gail': size is
greater than available space
```

From the preceding steps, you know that Gail's available space has been used up and the quota limit is still in force; therefore, you cannot make the storage reservation.

2. Remove the quota and the data files, and check the space utilization of the file systems.

```
root@s11-desktop:~# zfs set quota=none rpool/export/home/gail
```

This will clear the quota property. Gail can create data sets of any size that are not to exceed the total pool storage available.

```
root@s11-desktop:~# zfs get quota rpool/export/home/gail
NAME                    PROPERTY  VALUE  SOURCE
rpool/export/home/gail  quota     none   local

root@s11-desktop:~# rm /export/home/gail/*
root@s11-desktop:~# zfs list /export/home/gail
NAME                     USED  AVAIL  REFER  MOUNTPOINT
rpool/export/home/gail  33.5K  6.62G  33.5K  /export/home/gail
```

The `used` column shows the current space usage since the files were deleted.

```
root@s11-desktop:~# zfs list /export/home
NAME                USED  AVAIL  REFER  MOUNTPOINT
rpool/export/home  2.10M  6.62G    39K  /export/home
```

Note that the `used` column currently shows 2.10 MB of storage used.

3. Reserve 10 MB of storage for Gail.

```
root@s11-desktop:~# zfs set reservation=10M \
rpool/export/home/gail
root@s11-desktop:~# zfs get reservation rpool/export/home/gail
NAME                    PROPERTY     VALUE   SOURCE
rpool/export/home/gail  reservation  10M     local
```

4. Now check the file systems.

```
root@s11-desktop:~# zfs list /export/home/gail
NAME                     USED  AVAIL  REFER  MOUNTPOINT
rpool/export/home/gail  33.5K  6.62G  33.5K  /export/home/gail
```

Note that the reserved space has not been added to Gail's home directory.

```
root@s11-desktop:~# zfs list /export/home
NAME                USED  AVAIL  REFER  MOUNTPOINT
rpool/export/home  12.1M  6.61G    39K  /export/home
```

However, note that space has been reserved in `/export/home`, which is the parent data set. This demonstrates that reservations are considered in the used disk space calculation of the parent data set.

Task 3: Configure the `share` Property

In this task, you share Gail's home directory. In this situation, an assumption is made that her home directory contains an application documentation that is required by other users in other locations on the network. In the real world, you may have another application directory for this purpose that may need to be shared.

1. Verify that the S11-Server1 and S11-Desktop VMs are running.
2. Run the `zpool list` command to check the pools that are available. Use `zfs list` to display the file systems that are available. Create a file in Gail's directory.

```
root@s11-desktop:~# zpool list
NAME          SIZE  ALLOC   FREE   CAP  DEDUP  HEALTH  ALTROOT
rpool        39.5G  7.12G  32.4G  18%  1.00x  ONLINE  -

root@s11-desktop:~# zfs list
NAME                                USED  AVAIL  REFER  MOUNTPOINT
rpool                              7.18G  31.7G  4.97M  /rpool
rpool/ROOT                         5.10G  31.7G    31K  legacy
rpool/ROOT/solaris                 4.94G  31.7G  4.27G  /
rpool/ROOT/solaris/var              415M  31.7G   205M  /var
rpool/VARSHARE                      152K  31.7G  57.5K  /var/share
rpool/VARSHARE/pkg                   63K  31.7G    32K  /var/share/pkg
rpool/VARSHARE/pkg/repositories      31K  31.7G    31K
/var/share/pkg/repositories
rpool/VARSHARE/zones                 31K  31.7G    31K  /system/zones
rpool/dump                         1.03G  31.8G  1.00G  -
rpool/export                       11.2M  31.7G    32K  /export
rpool/export/home                  11.1M  31.7G    38K  /export/home
rpool/export/home/gail             33.5K  31.7G  33.5K
/export/home/gail
rpool/export/home/jholt              35K  31.7G    35K
/export/home/jholt
rpool/export/home/jmoose             35K  31.7G    35K
/export/home/jmoose
rpool/export/home/oracle            963K  31.7G   963K
/export/home/oracle
rpool/export/home/panna              35K  31.7G    35K
/export/home/panna
rpool/export/home/sstudent           41K  31.7G    41K
/export/home/sstudent
rpool/swap                         1.03G  31.8G  1.00G  -
root@s11-desktop:~# cd /export/home/gail
root@s11-desktop:/export/home/gail# touch crmreq
```

In Gail's home directory, you created the `crmreq` file.

3. Use the `chmod` command to change the permissions on Gail's home directory.

```
root@s11-desktop:/export/home/gail# chmod 777 /export/home/gail
root@s11-desktop:/export/home/gail# ls -ld /export/home/gail
drwxrwxrwx   2 gail     staff          5 Sep 21 01:47
/export/home/gail
```

You are setting these permissions only for training purposes. In the real world, you will use appropriate permissions as required by your business environment and the policies.

4. Share Gail's home directory with other users on the network.

```
root@s11-desktop:/export/home/gail# zfs set
share=name=gail,path=/export/home/gail,prot=nfs
rpool/export/home/gail
name=gail,path=/export/home/gail,prot=nfs

root@s11-desktop:/export/home/gail# zfs set share.nfs=on \
rpool/export/home/gail
```

Enable the `share` property on `/export/home/gail`.

```
root@s11-desktop:/export/home/gail# share
gail    /export/home/gail       nfs     sec=sys,rw
rpool_export_home_gail      /export/home/gail       nfs     sec=sys,rw
```

This confirms that the file system is being shared.

```
root@s11-desktop:/export/home/gail# svcs -a | grep nfs
disabled       23:05:00 svc:/network/nfs/cbd:default
online         23:05:00 svc:/network/nfs/client:default
online         23:05:54 svc:/network/nfs/fedfs-client:default
online          1:49:47 svc:/network/nfs/mapid:default
online          1:49:47 svc:/network/nfs/status:default
online          1:49:48 svc:/network/nfs/nlockmgr:default
online          1:49:50 svc:/network/nfs/rquota:default
online          1:49:51 svc:/network/nfs/server:default
```

The system has brought the NFS server online. It is always a good idea to check this.

Note: You may need to manually share the NFS file system if it fails to do so automatically.

If the NFS server is not enabled, issue the following command:

`# share -F nfs -o rw /export/home/gail`

5. Open a second terminal window and start an `ssh` session to S11-Server1. Assume administrator privileges.

```
oracle@s11-desktop:~$ ssh oracle@192.168.1.100
```

Note: Type `yes` for any RSA-related message.

```
Password: oracle1
Last login: Wed Sep 16 18:41:48 2015 from localhost
Oracle Corporation   SunOS 5.11       11.3   September 2015
oracle@s11-server1:~$ su -
Password: oracle1
Oracle Corporation   SunOS 5.11       11.3   September 2015
root@s11-server1:~#
```

6. Verify that you can see the shared directory on the Sol11-Server1 VM.

```
root@s11-server1:~# dfshares s11-desktop
RESOURCE                                  SERVER ACCESS    TRANSPORT
s11-desktop:/export/home/gail    s11-desktop  -          -
…
```

Yes, you can see the resource shared by the `s11-desktop` server.

7. Create the mount point and mount the shared resource.

```
root@s11-server1:~# mkdir /gaildir
root@s11-server1:~# mount -f nfs s11-desktop:/export/home/gail /gaildir
root@s11-server1:~# cd /gaildir
root@s11-server1:/gaildir# ls
crmreq
```

You can see the shared file `crmreq` in Gail's home directory.

```
root@s11-server1:/gaildir# touch crmdata
root@s11-server1:/gaildir# ls
crmdata  crmreq
```

Note: The `touch` command may take few minutes to create the `crmdata` file.

You can create another file in the shared directory, which means that you have read/write access.

8. Because you have finished working with Gail's directory, you can unmount it.

```
root@s11-server1:/gaildir# cd
root@s11-server1:~# umount /gaildir
```

If you are unable to unmount the `/gaildir directory` directory, use `-f` to unmount it.

root@s11-server1:~# umount -f /gaildir

9. End the `ssh` session to Sol11-Server1 VM and close the second terminal window.

```
root@s11-server1:~# exit
logout
oracle@s11-server1:~# exit
logout
Connection to 192.168.1.100 closed.
```

10. Continue working on the first terminal window. Stop sharing the directory.

```
root@s11-desktop:~# cd
root@s11-desktop:~# zfs set share.nfs=off rpool/export/home/gail
```

Task 4: Configure ZFS Compression

1. Verify that the S11-Desktop and S11-Server1 VMs are running.
2. Using the `zpool` command, create the `oraclecrm` pool using disks `c2t2d0` and `c2t3d0`. Run the `zfs list` command to list the space currently used by `oraclecrm`. Make a note of the value indicated.

```
root@s11-desktop:~# zpool create oraclecrm c2t2d0 c2t3d0
'oraclecrm' successfully created, but with no redundancy;
failure of one device will cause loss of the pool
root@s11-desktop:~# zfs list -r oraclecrm
NAME         USED  AVAIL  REFER  MOUNTPOINT
oraclecrm   89.5K  3.91G    31K  /oraclecrm
```

Currently, you have the pool available to you with no other file systems, which you confirm by using the `-r` option.

3. Use the `ls` command with the `–lh` options to list the size of the archive file in `/opt/ora/data`. Make a note of it.

```
root@s11-desktop:~# ls -lh /opt/ora/data/custarchive.tar
-rw-r—r--   1 root     root        3.0M Sep 21 00:17
/opt/ora/data/custarchive.tar
```

The new file takes up approximately 3.0 MB.

4. Create a directory named `/oraclecrm/cmp` to hold the files that you will copy to the file system.

```
root@s11-desktop:~# mkdir /oraclecrm/cmp
```

This directory will be used to store the compressed customer data.

5. Use the `zfs get` command to display the current settings of the `compression` and `compressratio` properties for `oraclecrm`. Verify that compression is off and the compression ratio is 1.00x.

```
root@s11-desktop:~# zfs get compression,compressratio oraclecrm
NAME       PROPERTY       VALUE     SOURCE
oraclecrm  compression    off       default
oraclecrm  compressratio  1.00x     -
```

The `compression` property is set to `off` by default. Because compression is `off`, the `compressratio` property is set to `1.00x`. A ratio of 1:1 for data means no compression.

6. Copy `/opt/ora/data/custarchive.tar` to `/oraclecrm/cmp/custarchive.tar`. List the file to display its size.

```
root@s11-desktop:~# cp /opt/ora/data/custarchive.tar \
/oraclecrm/cmp/custarchive.tar
root@s11-desktop:~# ls -lh /oraclecrm/cmp
total 6153
-rw-r--r--   1 root     root   3.0M Sep 21 02:07 custarchive.tar
```

After copying the file into the pool, it consumes approximately the same space.

7. Use the `zfs list` command to list the space used by `oraclecrm`.

```
root@s11-desktop:~# zfs list oraclecrm
NAME        USED  AVAIL  REFER  MOUNTPOINT
oraclecrm  3.10M  3.90G  3.04M  /oraclecrm
```

Does the space used match the size of `/oraclecrm/cmp/custarchive.tar`?

Yes, the `zfs list` command also confirms the same space consumption.

8. Use `zfs get` to verify that the compression ratio for `oraclecrm` is still 1.00x.

```
root@s11-desktop:~# zfs get compressratio oraclecrm
NAME       PROPERTY       VALUE  SOURCE
oraclecrm  compressratio  1.00x  -
```

Yes, `compressratio` is still unchanged.

9. Set the `compression` property for `oraclecrm` to `gzip` and verify that the new value is set.

```
root@s11-desktop:~# zfs set compression=gzip oraclecrm
root@s11-desktop:~# zfs get compression oraclecrm
```

```
NAME        PROPERTY     VALUE     SOURCE
oraclecrm   compression  gzip      local
```

You set the `compression` property on the `oraclecrm` file system to `gzip`. Now notice the space usage of the files, which get stored in the `oraclecrm` file system.

```
root@s11-desktop:~# zfs set compression=ggg oraclecrm
cannot set property for 'oraclecrm': 'compression' must be one
of 'on | off | lzjb | gzip | gzip-[1-9] | zle | lz4'
```

The purpose of this command is to demonstrate the different types of compression property values that are available. You intentionally specify `ggg` so that you can see valid property values.

Optionally, you can experiment with these compression types and compare the compression ratio.

Note: Oracle Solaris 11.3 supports the `LZ4` compression algorithm, which provides a `2x` compression ratio with lower CPU overhead. Enabling `LZ4` compression on ZFS file systems can reduce storage, power, and cooling in the `2x` through `5x` range.

10. Copy `/opt/ora/data/custarchive.tar` to `/oraclecrm/cmp/archive2.tar`. List all the files in `/oraclecrm/cmp` to display their sizes. Are the files in `/oraclecrm/cmp` the same size?

```
root@s11-desktop:~# cp /opt/ora/data/custarchive.tar \
/oraclecrm/cmp/archive2.tar
root@s11-desktop:~# ls -lh /oraclecrm/cmp
total 7923
-rw-r--r--   1 root     root        3.0M Aug 10 02:09 archive2.tar
-rw-r--r--   1 root     root        3.0M Aug 10 02:07 custarchive.tar
```

Yes, they are equal as displayed by the `ls` command.

11. Use the `zfs list` command to list the space used by `oraclecrm`.

```
root@s11-desktop:~# zfs list oraclecrm
NAME         USED  AVAIL  REFER  MOUNTPOINT
oraclecrm   3.96M  3.90G  3.90M  /oraclecrm
```

Does the space used match the sum of the size of the two files?

No, the output reports a smaller size than the sum of the two files. With reference to the preceding step, the sum of the space utilized by the two files would be 7.86 MB as against 3.96 MB displayed by the `zfs list` command.

12. Use the `zfs get` command to display the current setting of the `compressratio` property for `oraclecrm`. Notice that `compressratio` is now 1.54x.

```
root@s11-desktop:~# zfs get compressratio oraclecrm
NAME        PROPERTY        VALUE  SOURCE
oraclecrm   compressratio   1.54x  -
```

The ratio is `1.54x`, which means that data is being compressed at a ratio of 1.54:1 (approximately 54%).

13. Copy `/opt/ora/data/custarchive.tar` to `/oraclecrm/cmp/archive3.tar`. List all the files in `/oraclecrm/cmp` to display their sizes.

```
root@s11-desktop:~# cp /opt/ora/data/custarchive.tar \
/oraclecrm/cmp/archive3.tar
root@s11-desktop:~# ls -lh /oraclecrm/cmp
total 5053
-rw-r--r--   1 root     root        3.0M Aug 10 02:09 archive2.tar
-rw-r--r--   1 root     root        3.0M Aug 10 02:12 archive3.tar
-rw-r--r--   1 root     root        3.0M Aug 10 02:07 custarchive.tar
```

Are the files in `/oraclecrm/cmp` the same size? *Yes, they are.*

14. Use the `du –h` command to display the space used by the files in `/oraclecrm/cmp`.

```
root@s11-desktop:~# du -h /oraclecrm/cmp/*
 885K   /oraclecrm/cmp/archive2.tar
 885K   /oraclecrm/cmp/archive3.tar
 3.0M   /oraclecrm/cmp/custarchive.tar
```

How does the amount of space used by these files compare?

The `custarchive.tar` file uses the same space as the `ls -lh` command indicates. The other two files show a percentage of the original size of the files. The `custarchive.tar` file was created in the `cmp` file system before enabling compression. This was done intentionally, so that you can see the difference between space usage by compressed and uncompressed files.

15. Use the `zfs get` command to display the current value of the `compressratio` property for `oraclecrm`.

```
root@s11-desktop:~# zfs get compressratio oraclecrm
NAME        PROPERTY       VALUE  SOURCE
oraclecrm   compressratio  1.89x  -
```

What is the current compression ratio? How has it changed and why?

The compression ratio is now `1.89x`. It has increased with the addition of the second compressed file. A larger portion of the data in the pool is now being compressed. This demonstrates that as you add more data files in a ZFS file system with compression enabled, compression further reduces space utilization.

16. Remove the `/oraclecrm/cmp/custarchive.tar` file.

```
root@s11-desktop:~# rm /oraclecrm/cmp/custarchive.tar
```

17. Use the `zfs get` command to display the current value of the `compressratio` property for `oraclecrm`.

```
root@s11-desktop:~# zfs get compressratio oraclecrm
NAME       PROPERTY       VALUE  SOURCE
oraclecrm  compressratio  3.43x  -
```

What is the current compression ratio? How has it changed and why?

The compression ratio has increased again with the removal of the uncompressed file.

18. Use the `zfs list` command to list the space used by `oraclecrm` and `du –h` to list the space used by the remaining two files in `/oraclecrm/cmp`.

```
root@s11-desktop:~# zfs list oraclecrm
NAME        USED  AVAIL  REFER  MOUNTPOINT
oraclecrm  1.82M  3.90G  1.77M  /oraclecrm

root@s11-desktop:~# du -h /oraclecrm/cmp/*
 885K   /oraclecrm/cmp/archive2.tar
 885K   /oraclecrm/cmp/archive3.tar
```

Does the refer value reported by `zfs list` reflect the sum of the space used by the two files in `/oraclecrm/cmp`?

Yes, the two values are correlated.

19. Using the `zpool` destroy command, delete the `oraclecrm` pool. Confirm the action.

```
root@s11-desktop:~# zpool destroy oraclecrm
root@s11-desktop:~# zpool list
NAME   SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
rpool  15.6G  8.66G  6.96G  55%  1.00x  ONLINE  -
```

You have destroyed the pool because you have finished using it.

Practice 4-4: Troubleshooting ZFS Failures

Overview

In this practice, you will work with ZFS device and data problems. For demonstration purposes, you will simulate the problems and correct the problems. This practice includes the following activities:

- Troubleshooting ZFS device issues
- Troubleshooting ZFS data errors

Task 1: Troubleshooting ZFS Device Issues

This task includes the following activities:

- Creating ZFS components
- Configuring `syslog` for Fault Manager Daemon (FMD) messages
- Troubleshooting a ZFS device error in a `raidz` pool

Task 1A: Creating the ZFS Components

1. Verify that the S11-Desktop and S11-Server1 VMs are running.
2. Using the `zpool` commands, create a `raidz` pool with three virtual devices. Verify the results.

```
root@s11-desktop:~# format
Searching for disks...done

AVAILABLE DISK SELECTIONS:
      0. c2t0d0 <Unknown-Unknown-0001-16.00GB>
         /xpvd/xdf@51712
       1. c2t2d0 <Unknown-Unknown-0001-2.00GB>
         /xpvd/xdf@51744
       2. c2t3d0 <Unknown-Unknown-0001-2.00GB>
         /xpvd/xdf@51760
       3. c2t4d0 <Unknown-Unknown-0001-2.00GB>
         /xpvd/xdf@51776
       4. c2t5d0 <Unknown-Unknown-0001-2.00GB>
         /xpvd/xdf@51792
       5. c2t6d0 <Unknown-Unknown-0001 cyl 1024 alt 0 hd 128 sec 32>
         /xpvd/xdf@51808
       6. c2t7d0 <Unknown-Unknown-0001 cyl 1024 alt 0 hd 128 sec 32>
         /xpvd/xdf@51824
Specify disk (enter its number): ^C

root@s11-desktop:~# zpool create assetpool raidz c2t3d0 c2t4d0 c2t5d0
root@s11-desktop:~# zpool list
NAME        SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
assetpool  5.94G   253K  5.94G   0%  1.00x  ONLINE  -
rpool      15.6G  8.66G  6.96G  55%  1.00x  ONLINE  -
```

```
root@s11-desktop:~# zpool status assetpool
  pool: assetpool
 state: ONLINE
  scan: none requested
config:

    NAME          STATE     READ WRITE CKSUM
    assetpool     ONLINE       0     0     0
      raidz1-0    ONLINE       0     0     0
        c2t3d0    ONLINE       0     0     0
        c2t4d0    ONLINE       0     0     0
        c2t5d0    ONLINE       0     0     0

errors: No known data errors
root@s11-desktop:~# zpool status -x
all pools are healthy
```

3. Use the `zfs` command to create an `inventory` file system in your `assetpool`.

```
root@s11-desktop:~# zfs create assetpool/inventory
root@s11-desktop:~# zfs mount | grep inventory
assetpool/inventory             /assetpool/inventory
root@s11-desktop:~# ls -lh /opt/ora/data/custarchive.tar
-rw-r—r--   1 root     root       3.0M Sep 21  00:17
/opt/ora/data/custarchive.tar
```

For training purposes, you use the `custarchive.tar` file to simulate business application files.

4. Use the `cp` command to copy the `custarchive` file into the `inventory` file system.

```
root@s11-desktop:~# cp /opt/ora/data/custarchive.tar \
 /assetpool/inventory/custarchive.tar
```

Task 1B: Configuring `syslog` for FMD Messages

1. Create a new file named `/var/adm/messages.fmd` for Fault Management Daemon to log the device-related messages.

```
root@s11-desktop:~# touch /var/adm/messages.fmd
```

2. Back up the current `/etc/syslog.conf` file.

```
root@s11-desktop:~# cp /etc/syslog.conf /etc/syslog.conf.orig
```

3. Edit the `/etc/syslog.conf` file. Enter a new line below the existing line as shown.

```
root@s11-desktop:~# pfedit /etc/syslog.conf
```

Existing line:

```
*.err;kern.debug;daemon.notice;auth.none;mail.crit   /var/adm/messages
```

New line:

```
daemon.err                              /var/adm/messages.fmd
```

Make it look similar to the following:

```
*.err;kern.debug;daemon.notice;auth.none;mail.crit   /var/adm/messages
daemon.err                              /var/adm/messages.fmd
```

Remember to separate the columns by using tabs.

What is the purpose of this entry in `syslog`? *This step will ensure that all ZFS device-related messages are logged in a separate file for this practice*.

(Normally, FMD writes hardware-related messages to the `/var/adm/messages` file.)

4. Use the `svcadm` command to refresh the `syslog` service for the new configuration to take effect.

```
root@s11-desktop:~# svcadm refresh system-log
```

Task 1C: Troubleshooting a ZFS Device Error in a `raid-z` Pool

1. Verify that you can read the contents of your data file `/assetpool/inventory/custarchive.tar`.

```
root@s11-desktop:~# tar tvf /assetpool/inventory/custarchive.tar
(output omitted)
```

Can you access your data in the inventory file system? *Yes*

Note that the contents are irrelevant in this situation. The output of the file that you are viewing was created to simulate a business application data file and is only for training purposes.

2. Display the status of `assetpool` and verify that all devices are online.

```
root@s11-desktop:~# zpool status assetpool
  pool: assetpool
 state: ONLINE
  scan: none requested
config:

        NAME         STATE     READ WRITE CKSUM
        assetpool    ONLINE       0     0     0
          raidz1-0   ONLINE       0     0     0
            c2t3d0   ONLINE       0     0     0
            c2t4d0   ONLINE       0     0     0
            c2t5d0   ONLINE       0     0     0
```

```
errors: No known data errors
```

3. Use the `prtvtoc` command to display the current `vtoc` configuration of the `c2t5d0` disk.

```
root@s11-desktop:~# prtvtoc /dev/rdsk/c2t5d0
* /dev/rdsk/c2t5d0 partition map
*
* Dimensions:
*     512 bytes/sector
* 2097152 sectors
* 2097085 accessible sectors
*
* Flags:
*   1: unmountable
*  10: read-only
*
* Unallocated space:
*    First     Sector    Last
*    Sector     Count    Sector
*      34       222       255
*
*                            First     Sector    Last
* Partition  Tag  Flags     Sector      Count    Sector  Mount Directory
       0      4    00          256    2080479   2080734
       8     11    00      2080735      16384   2097118
```

Note that you will be working with the highlighted slice `0` entry.

4. Save `vtoc` and cause the `c1t5d0` disk to appear as failed. Use the `/var/tmp/vtoc5` file as indicated to make slice `0` disappear.

```
root@s11-desktop:~# prtvtoc /dev/rdsk/c2t5d0 > /var/tmp/vtoc5.orig
root@s11-desktop:~# prtvtoc /dev/rdsk/c2t5d0 > /var/tmp/vtoc5
```

Note that you have saved a copy of `c2t5d0` `vtoc` to two files because you will modify the `/var/tmp/vtoc5` file and keep `/var/tmp/vtoc5.orig` as a copy of your original `vtoc` configuration.

Delete the slice `0` configuration from `vtoc` (the highlighted entry in the preceding step).

```
root@s11-desktop:~# pfedit /var/tmp/vtoc5
```

Verify that the slice `0` line is deleted.

```
root@s11-desktop:~# tail /var/tmp/vtoc5
*  10: read-only
*
* Unallocated space:
*    First     Sector    Last
```

```
*    Sector     Count    Sector
*         34       222       255
*
*                          First     Sector    Last
* Partition  Tag  Flags    Sector     Count    Sector  Mount Directory
       8      11    00    2080735     16384   2097118
```

Is the slice `0` line available? *No, it has been deleted.*

What is the purpose of deleting this entry? *So that you can simulate a device problem*

The system will not be able to use this disk because its `vtoc` configuration is not available, thus affecting the ZFS pool.

5. Use the `fmthard` command to copy the modified `vtoc` to the disk.

```
root@s11-desktop:~# fmthard -s /var/tmp/vtoc5 /dev/rdsk/c2t5d0s0
fmthard:  New volume table of contents now in place.
```

What is the purpose of this command? *To overlay the current `c2t5d0` `vtoc`*

6. Repeat steps 1 and 2 in the current task.

   Question: Why is the system showing no errors with disk `c2t5d0`, whereas its `vtoc` is corrupted?

   Answer: *Because the system is working with `vtoc` and its configuration from memory. You need to recycle the disk.*

7. Use the `zpool` command to take the disk offline and attempt to put it back online. Display the status of the pool.

```
root@s11-desktop:~# zpool offline assetpool c2t5d0
root@s11-desktop:~# zpool online assetpool c2t5d0
warning: device 'c2t5d0' onlined, but remains in faulted state
use 'zpool clear' to restore a faulted device
root@s11-desktop:~# zpool status assetpool
  pool: assetpool
 state: DEGRADED
status: One or more devices are unavailable in response to persistent
        errors. Sufficient replicas exist for the pool to continue
        functioning in a degraded state.
action: Determine if the device needs to be replaced, and clear the
        errors using 'zpool clear' or 'fmadm repaired', or replace the
        device with 'zpool replace'.
        Run 'zpool status -v' to see device specific details.
  scan: none requested
config:

     NAME         STATE     READ WRITE CKSUM
     assetpool    DEGRADED     0     0     0
       raidz1-0   DEGRADED     0     0     0
         c2t3d0   ONLINE       0     0     0
```

```
        c2t4d0   ONLINE        0     0     0
        c2t5d0   UNAVAIL       0     0     0
errors: No known data errors
```

In your `raidz` pool, is disk `c2t5d0` available? *No, it cannot be opened.*
Note that the message displayed on your system may be different.

8. Use the `more` command to view the contents of your `/var/adm/messages.fmd` log file.

```
root@s11-desktop:~# more /var/adm/messages.fmd
Nov  7 04:05:39 s11-desktop fmd: [ID 377184 daemon.error] SUNW-MSG-ID: ZFS-
8000-LR, TYPE: Fault, VER: 1, SEVE
RITY: Major
Nov  7 04:05:39 s11-desktop EVENT-TIME: Mon Nov  7 04:05:39 PST 2016
Nov  7 04:05:39 s11-desktop PLATFORM: HVM domU, CSN: 5665f2dc-eec4-513c-8125-
94c477d38798, HOSTNAME: s11-desk
top
Nov  7 04:05:39 s11-desktop SOURCE: zfs-diagnosis, REV: 1.0
Nov  7 04:05:39 s11-desktop EVENT-ID: 936a99c6-3ad4-4f03-a972-f64563e1a0c7
Nov  7 04:05:39 s11-desktop DESC: ZFS device 'c2t5d0' in pool 'assetpool'
failed to open.
Nov  7 04:05:39 s11-desktop AUTO-RESPONSE: An attempt will be made to activate
a hot spare if available.
Nov  7 04:05:39 s11-desktop IMPACT: Fault tolerance of the pool may be
compromised.
Nov  7 04:05:39 s11-desktop REC-ACTION: Use 'fmadm faulty' to provide a more
detailed view of this event. Run
 'zpool status -lx' for more information. Please refer to the associated
reference document at http://support
.oracle.com/msg/ZFS-8000-LR for the latest service procedures and policies
regarding this diagnosis.
root@s11-desktop:~#
```

The FMD facility logged the device corruption messages in the configured file.

9. Use the `zpool` command to replace the faulty disk with an available disk. Clear any pool-level errors logged by ZFS. Verify the results.

```
root@s11-desktop:~# zpool replace assetpool c2t5d0 c2t2d0
```

Which disk is replacing which disk? *You are replacing `c2t5d0` with `c2t2d0`.*

```
root@s11-desktop:~# zpool clear assetpool
root@s11-desktop:~# zpool status assetpool
  pool: assetpool
 state: ONLINE
  scan: resilvered 1.56K in 0h0m with 0 errors on Tue Sep 22
02:24:33 2015
config:

    NAME         STATE     READ WRITE CKSUM
    assetpool    ONLINE       0     0     0
```

```
      raidz1-0  ONLINE       0     0     0
        c2t3d0  ONLINE       0     0     0
        c2t4d0  ONLINE       0     0     0
        c2t2d0  ONLINE       0     0     0

errors: No known data errors
```

Has the faulty disk been replaced? *Yes*

Is the pool healthy? *Yes*

10. Use the `scrub` command to have ZFS streamline the data in the `raidz` pool.

```
root@s11-desktop:~# zpool scrub assetpool
root@s11-desktop:~# zpool status assetpool
  pool: assetpool
 state: ONLINE
 scan: scrub repaired 0 in 0h0m with 0 errors on Sep 21 02:38:26
2015
config:

    NAME         STATE     READ WRITE CKSUM
    assetpool    ONLINE       0     0     0
      raidz1-0   ONLINE       0     0     0
        c2t3d0   ONLINE       0     0     0
        c2t4d0   ONLINE       0     0     0
        c2t2d0   ONLINE       0     0     0

errors: No known data errors
```

Your display may be a bit different.

What is the purpose of the scrub operation? *To ensure data population on the new disk*

11. Using the `zpool` command, destroy the `assetpool` pool.

```
root@s11-desktop:~# zpool destroy assetpool
```

Task 2: Troubleshooting ZFS Data Errors in a Mirror Pool

In this task, you inject errors into your data file. Then you implement corrective measures to make sure that the data is restored from the mirror copy.

The following activities are covered in this task:

- Running an explicit scrub
- Restoring data in the mirror pool

Note: Your command output displays may be different from the displays in the practice. In some cases, ZFS may indicate a different number of errors or no errors. It may show errors at different points in the process based on when it performs certain internal data integrity processes, for example, the scrub operation. The steps in this task demonstrate multiple possible scenarios to assist in understanding why your output would be unpredictable. Some of the factors governing this unpredictability are:

- ZFS is monitoring the errors but can discover all the data errors only after a full scrub. Based on where it is in the scrub process, it will be able to display the errors discovered so far. So for this reason, the number can change in subsequent status displays.
- Because ZFS is performing the scrub operation periodically, it depends on when it is launched. This will affect the timing of the results displayed to you.
- Based on the volume of data generated, ZFS may be able to work with the same disk or use the spare disk.
- Based on multiple variables in the situation, you will get different output every time you perform this task.

The main objective of this task is to demonstrate a situation where the results can be different with every iteration of the task, while at the same time showing you how ZFS discovers and corrects the errors. This process of discovering and repairing is called self-healing, which is an extremely useful function of ZFS.

1. Use the `zpool` command and create a mirror pool. Check the health of the pool.

```
root@s11-desktop:~#zpool create assetpool mirror c2t3d0 c2t4d0 \
spare c2t5d0
root@s11-desktop:~# zpool status assetpool
  pool: assetpool
 state: ONLINE
  scan: none requested
config:

    NAME         STATE      READ WRITE CKSUM
    assetpool    ONLINE        0     0     0
      mirror-0   ONLINtE        0     0     0
        c2t3d0   ONLINE        0     0     0
        c2t4d0   ONLINE        0     0     0
    spares
      c2t5d0     AVAIL

errors: No known data errors
```

2. Use the `tar` command to create a demonstration data file. Let it generate data for a minute or more, and then break the command.

```
root@s11-desktop:~# tar cvf /assetpool/data.tar /usr
…
…
/usr/bin/nvidia-xconfig
/usr/bin/alacarte
/usr/bin/iceauth
/usr/bin/ps2ascii
/usr/bin/gvfs-mount
```

```
/usr/bin/pmap
/usr/bin/smproxy
/usr/bin/pkglint
/usr/bin/nautilus-connect-server
…
<Ctrl+C>
root@s11-desktop:~# zfs list /assetpool
NAME        USED  AVAIL  REFER  MOUNTPOINT
assetpool  204M  772M   203M  /assetpool
```

For training purposes, you are creating a data file with a significant amount of data in it. Your displays and data will be different.

3. Use the `dd` command to corrupt the data on the first disk.

```
root@s11-desktop:~# dd if=/dev/zero of=/dev/dsk/c2t3d0 oseek=100
bs=8192 count=10000 conv=notrunc
10000+0 records in
10000+0 records out
```

If you are not familiar with the `dd` command, refer to the man pages. Using full blocks, you are overlaying 10,000 blocks of 8 kilobytes with zeros. Because you are using the `oseek` option, you are bypassing the beginning data (VTOC and other system-reserved sectors) on the disk.

4. Using the `zpool` command, scrub the data on the pool, and display the pool's health.

```
root@s11-desktop:~# zpool scrub assetpool
```

5. Use the `zpool` command to display the status of the pool.

```
root@s11-desktop:~# zpool status assetpool
  pool: assetpool
 state: DEGRADED
status: One or more devices has been diagnosed as degraded. An
        attempt was made to correct the error. Applications are
        unaffected.
action: Determine if the device needs to be replaced, and clear
        the errors using 'zpool clear' or 'fmadm repaired', or
        replace the device with 'zpool replace'.
        Run 'zpool status -v' to see device specific details.
  scan: resilvered 204M in 0h0m with 0 errors on Sep 22 02:46:53
2015
config:

    NAME           STATE     READ WRITE CKSUM
    assetpool      DEGRADED     0     0     0
      mirror-0     DEGRADED     0     0     0
        spare-0    DEGRADED     0     0     0
```

```
            c2t3d0  DEGRADED      0     0   606
            c2t5d0  ONLINE        0     0     0
          c2t4d0    ONLINE        0     0     0
      spares
        c2t5d0      INUSE

errors: No known data errors
```

Note the checksum errors on the disk `c2t3d0`. ZFS has discovered some data errors.
ZFS discovers the errors based on multiple factors and one of them is when it performs the scrub.

6. Using the `fmadm faulty` command, display the status information for resources that the Fault Manager currently believes to be faulty.

   Note: Observe the Suspect 1 of 1 section of the output and use the highlighted text in step 7.

```
root@s11-desktop:~# fmadm faulty
--------------- ------------------------------------  -------------- ---------
TIME            EVENT-ID                              MSG-ID         SEVERITY
--------------- ------------------------------------  -------------- ---------
Nov 07 04:18:49 6ad5efd1-c7b0-4330-aab6-ca2b649eed0e  ZFS-8000-GH    Major

Problem Status    : open
Diag Engine       : zfs-diagnosis / 1.0
System
    Manufacturer  : unknown
    Name          : unknown
    Part_Number   : unknown
    Serial_Number : unknown

System Component
    Manufacturer  : Xen
    Name          : HVM domU
    Part_Number   : unknown
    Serial_Number : 5665f2dc-eec4-513c-8125-94c477d38798
    Host_ID       : 0005469f

----------------------------------------
Suspect 1 of 1 :
   Problem class : fault.fs.zfs.vdev.checksum
   Certainty   : 100%
   Affects     :
zfs://pool=3982a1e3923f55c2/vdev=a2a199e2f1ca3875/pool_name=assetpool/vdev_nam
e=c2t3d0
   Status      : faulted but still providing degraded service

   FRU
```

```
     Status           : faulty
     FMRI             :
"zfs://pool=3982a1e3923f55c2/vdev=a2a199e2f1ca3875/pool_name=assetpool/vdev_na
me=c2t3d0"

Description : The number of checksum errors associated with ZFS device
'c2t3d0'
              in pool 'assetpool' exceeded acceptable levels.

Response    : The device has been marked as degraded. An attempt will be made
              to activate a hot spare if available.

Impact      : Fault tolerance of the pool may be compromised.

Action      : Use 'fmadm faulty' to provide a more detailed view of this
event.
              Run 'zpool status -lx' for more information. Please refer to the
              associated reference document at
              http://support.oracle.com/msg/ZFS-8000-GH for the latest service
              procedures and policies regarding this diagnosis.

--------------- ------------------------------------  -------------- ---------
TIME            EVENT-ID                              MSG-ID         SEVERITY
--------------- ------------------------------------  -------------- ---------
Nov 04 05:27:27 30ab2a39-61d0-43a7-83dc-b03595b275aa  SMF-8000-YX    major

Problem Status    : isolated
Diag Engine       : software-diagnosis / 0.1
System
    Manufacturer  : unknown
    Name          : unknown
    Part_Number   : unknown
    Serial_Number : unknown

System Component
    Manufacturer  : Xen
    Name          : HVM domU
    Part_Number   : unknown
    Serial_Number : 5665f2dc-eec4-513c-8125-94c477d38798
    Host_ID       : 0005469f

----------------------------------------
Suspect 1 of 1 :
   Problem class : defect.sunos.smf.svc.maintenance
   Certainty   : 100%
   Affects     : svc:///site/crmsvc:default
   Status      : faulted and taken out of service

   Resource
     FMRI             : "svc:///site/crmsvc:default"
     Status           : faulted and taken out of service
```

```
Description : A service failed - a method is failing in a retryable manner but
              too often.

Response    : The service has been placed into the maintenance state.

Impact      : svc:/site/crmsvc:default is unavailable.

Action      : Run 'svcs -xv svc:/site/crmsvc:default' to determine the generic
              reason why the service failed, the location of any logfiles, and
              a list of other services impacted. Please refer to the
associated
              reference document at http://support.oracle.com/msg/SMF-8000-YX
              for the latest service procedures and policies regarding this
              diagnosis.

root@s11-desktop:~#
```

7. Using the `fmadm repaired` command, notify the Fault Manager that a repair procedure has been carried out on the specified resource.

   Hint: If you do not want to type the resource name, copy the resource name from the output of the previous command.

```
root@s11-desktop:~# fmadm repaired
zfs://pool=3982a1e3923f55c2/vdev=a2a199e2f1ca3875/pool_name=assetpool/
vdev_name=c2t3d0
fmadm: recorded repair to
zfs://pool=3982a1e3923f55c2/vdev=a2a199e2f1ca3875/pool_name=assetpool/
vdev_name=c2t3d0
```

Note: The `fmadm repaired` subcommand should be used only at the direction of a documented repair procedure. Administrators might need to apply additional commands to re-enable a previously faulted resource. For more information about the `fmadm` command, refer to the `fmadm` (1M) man page.

8. Using the `zpool` command, clear the errors and display the pool's status.

```
root@s11-desktop:~# zpool clear assetpool
root@s11-desktop:~# zpool status assetpool
  pool: assetpool
 state: ONLINE
  scan: resilvered 204M in 0h0m with 0 errors on Tue Sep 11
02:46:53 2015
config:

    NAME         STATE      READ WRITE CKSUM
    assetpool    ONLINE        0     0     0
      mirror-0   ONLINE        0     0     0
        c2t3d0   ONLINE        0     0     0
        c2t4d0   ONLINE        0     0     0
    spares
```

```
       c2t5d0    AVAIL

errors: No known data errors
```

By clearing the errors, now the corrupted disk seems to be operational and does not report any errors.

9. Using the `tar` command, display your data.

```
root@s11-desktop:~# tar tvf /assetpool/data.tar
…
…
…
tar: Removing leading '/' from '/usr/platform/i86xpv/'
drwxr-xr-x   0/3        0 Aug 21 11:13 2015 usr/platform/i86xpv/
tar: Removing leading '/' from '/usr/platform/i86xpv/lib/'
drwxr-xr-x   0/2        0 Aug 21 11:13 2015
usr/platform/i86xpv/lib/
tar: Removing leading '/' from '/usr/platform/i86xpv/lib/mdb/'
drwxr-xr-x   0/3        0 Aug 21 11:13 2015
usr/platform/i86xpv/lib/mdb/
tar: Removing leading '/' from
'/usr/platform/i86xpv/lib/mdb/kvm/'
drwxr-xr-x   0/3        0 Aug 21 11:13 2015
usr/platform/i86xpv/lib/mdb/kvm/
tar: Removing leading '/' from
'/usr/platform/i86xpv/lib/mdb/kvm/amd64/'
drwxr-xr-x   0/3        0 Aug 21 11:22 2015
usr/platform/i86xpv/lib/mdb/kvm/amd64/
tar: Removing leading '/' from
'/usr/platform/i86xpv/lib/mdb/kvm/amd64/unix.so'
-r-xr-xr-x   0/3   133352 Jan  7 02:49 2015
usr/platform/i86xpv/lib/mdb/kvm/amd64/unix.so
tar: Removing leading '/' from
'/usr/platform/i86xpv/lib/mdb/kvm/amd64/xpv_psm.so'
-r-xr-xr-x   0/3   123016 Jan  7 02:49 2015
usr/platform/i86xpv/lib/mdb/kvm/amd64/xpv_psm.so…
…
…
< CTRL+C>
```

Is your data still there? *Yes*

10. Using the `zpool destroy` command, delete the pool.

```
root@s11-desktop:~# zpool destroy assetpool
root@s11-desktop:~# zpool list
NAME    SIZE  ALLOC   FREE  CAP  DEDUP  HEALTH  ALTROOT
rpool  15.6G  8.67G  6.96G  55%  1.00x  ONLINE  -
```

This concludes the ZFS troubleshooting topic.

11. Close all the terminal windows.

Practices for Lesson 5: Configuring the Network

Chapter 5

Practice for Lesson 5: Overview

Practices Overview

Following the predeployment test plan, it is now time to review the Oracle Solaris 11.3 high availability features. Your company's business applications, such as Oracle CRM, work with data that is being transmitted via the network interfaces configured on server and client hosts. Because you will be monitoring the transaction traffic load and managing the network interfaces, it is critical for you to know how the networking is configured. To provide you with an orientation to the network, the following topics are covered in this practice:

- Configuring an Elastic Virtual Switch (EVS)
- Configuring link aggregation
- Configuring IP multipathing

Note: Your command output displays can be different from the displays in the practice, especially storage, processes, and other session-oriented content.

Look at your checklist to see where you are. You have just completed managing the business application data and you are now ready to test the network configuration and network failover.

	Oracle Solaris 11 Predeployment Checklist
✓	Managing Services and Service Properties by Using SMF
✓	Managing Software Packages by Using IPS
✓	Managing Data Backup and Restore by Using ZFS
	Configuring the Network
	Administering Network Services
	Advanced Administration of Zones
	Securing the Oracle Solaris 11 OS
	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practice 5-1: Configuring an Elastic Virtual Switch (Demonstration)

Overview

Starting with the Oracle Solaris 11.2 release, you can use the Oracle Solaris Elastic Virtual Switch (EVS) feature to manage multiple virtual switches that are spread across several physical machines. An elastic virtual switch represents an isolated L2 segment, and the isolation is implemented through VLANs or VXLANs. Every elastic virtual switch is associated with a name, virtual ports, and a block of IP addresses. You can create, monitor, and control the virtual switch resources.

A demonstration is provided to help you understand how to configure EVS. In the demonstration, you can observe how to:

- Install the mandatory EVS packages
- Set up SSH authentication
- Set up EVS controller
- Configure compute nodes

Note: Before viewing the demonstration file, it is necessary that you understand the detailed procedure documented in the "Configuring a Virtual Switch" section of the Student Guide.

Assumptions

Adobe Flash Player is already installed on the host machine before executing the demonstration.

Special note for playing the demonstration in the virtual machine:

- To be able to view demonstration controls in the browser, it is recommended to switch to full screen.
- To switch to full-screen mode in the browser window, go to **View** > **Full Screen**.

Tasks

Perform the following steps on your host machine:

1. Open a terminal window.
2. Change to the `/opt/ora/demo/Configuring_EVS` directory.

```
# cd /opt/ora/demo/Configuring_EVS
# ls
standard.js
Configuring_EVS_Demo.htm
Configuring_EVS_Demo.swf
```

3. Open the `Configuring_EVS_Demo.htm` file in a web browser.

```
# firefox Configuring_EVS_Demo.htm &
```

4. A browser window with the Flash demonstration is displayed.
5. Close the terminal window.
6. Close the web browser after you complete viewing the Flash demonstration.

Practice 5-2: Configuring a Link Aggregation

Overview

Link aggregation requires at least two network interfaces. The network interfaces must be unplumbed before they can be aggregated. In this practice, you combine four network interfaces into one link aggregation called `crmpipe0` to create a larger network pipe for the CRM application. Then you manage the interfaces, which includes removing, adding, and eventually deleting the `crmpipe0` link aggregation. This portrays different network management situations while working with the CRM application (for example, adjusting the bandwidth as needed).

Task 1: Configuring a Link Aggregation

1. Verify that the S11-Desktop VM is running. Open a new terminal window and assume administrator privileges. Disable IP filtering.

```
root@s11-desktop:~# ipf -D
```

2. Enable the `DefaultFixed` network profile.

```
root@s11-desktop:~# netadm enable –p ncp DefaultFixed
Enabling ncp ‘DefaultFixed’
```

3. Delete the IP interface for the `net0` data link.

```
root@s11-desktop:~# ipadm delete-ip net0
```

4. List the network links that are currently configured in the system.

```
root@s11-desktop:~# dladm show-link
LINK     CLASS      MTU   STATE          OVER
net1     phys       1500  unknown        --
net2     phys       1500  unknown        --
net0     phys       1500  unknown        --
net3     phys       1500  unknown        --
```

5. Create a link aggregation named `crmpipe0` that consists of the `net0`, `net1`, `net2`, and `net3` network interfaces, and show the results.

```
root@s11-desktop:~# dladm create-aggr -l net0 -l net1 \
-l net2 -l net3 crmpipe0
root@s11-desktop:~# dladm show-link
LINK      CLASS      MTU   STATE    OVER
net1      phys       1500  up       --
net2      phys       1500  up       --
net0      phys       1500  up       --
net3      phys       1500  up       --
crmpipe0  aggr       1500  up       --     net0 net1 net2 net3
root@s11-desktop:~# dladm show-aggr
LINK            MODE  POLICY   ADDRPOLICY      LACPACTIVITY LACPTIMER
crmpipe0        trunk L4       auto            off          short
root@s11-desktop:~#
```

6. Create an IP interface for the `crmpipe0` data link and show the results.

```
root@s11-desktop:~# ipadm create-ip crmpipe0
root@s11-desktop:~# ipadm show-if
IFNAME     CLASS    STATE    ACTIVE OVER
lo0        loopback ok       yes    --
crmpipe0   ip       down     no     --
```

7. Run the `ipadm` command to create the static IPv4 address for the `s11-server1` system on the `crmpipe0` interface, and show the results.

```
root@s11-desktop:~# ipadm create-addr -T static \
-a 192.168.1.200/24 crmpipe0/v4
root@s11-desktop:~# ipadm show-addr
ADDROBJ            TYPE     STATE   ADDR
lo0/v4             static   ok       127.0.0.1/8
crmpipe0/v4        static   ok       192.168.1.200/24
lo0/v6             static   ok       ::1/128
```

8. Log in to the S11-Server1 system and use the `ping` command to verify connectivity to the S11-Desktop server.

```
root@s11-server1:~# ping s11-desktop
s11-desktop is alive
```

Note: Reboot the system if the `ping` command does not work.

Task 2: Removing the Link Aggregation

Note: You will remove the link aggregation now because you want to keep these links unconfigured as required for the next practice.

1. From Sol11-Desktop, delete the `crmpipe0` IP interface by using the `ipadm` command.

```
root@s11-desktop:~# ipadm delete-ip crmpipe0
root@s11-desktop:~# ipadm show-addr
ADDROBJ           TYPE     STATE        ADDR
lo0/v4            static   ok           127.0.0.1/8
lo0/v6            static   ok           ::1/128
root@s11-desktop:~# dladm show-link
LINK             CLASS       MTU    STATE    OVER
net1             phys        1500   up       --
net2             phys        1500   up       --
net0             phys        1500   up       --
net3             phys        1500   up       --
crmpipe0         aggr        1500   up       net0 net1 net2 net3
```

2. Using the `dladm` command, delete the `crmpipe0` aggregation.

```
root@s11-desktop:~# dladm delete-aggr crmpipe0
root@s11-desktop:~# dladm show-link
LINK             CLASS     MTU    STATE    OVER
net1             phys      1500   unknown  --
net2             phys      1500   unknown  --
net0             phys      1500   unknown  --
net3             phys      1500   unknown  --
root@s11-desktop:~# ipadm show-if
IFNAME     CLASS    STATE    ACTIVE OVER
lo0        loopback ok       yes    --
```

The link aggregation has been removed.

Note: At this time, you want to keep these links unconfigured because they will be needed in this state for the next practice.

Practice 5-3: Configuring IPMP

Overview

IP network multipathing (IPMP) provides physical interface failure detection, transparent network access failover, and packet load balancing.

An IPMP configuration typically consists of two or more physical interfaces on the same system that are attached to the same LAN. These interfaces can belong to an IPMP group in either of the following configurations:

- **Active-active configuration:** In this configuration, all underlying interfaces are active. An active interface is an IP interface that is currently available for use by the IPMP group. By default, an underlying interface becomes active when you configure the interface to become a part of an IPMP group.
- **Active-standby configuration:** In this configuration, at least one interface is administratively configured as standby. If an active interface fails, the standby interface is automatically deployed as needed. You can configure as many standby interfaces as you want for an IPMP group.

In this practice, you configure both active-active and active-standby configurations.

Task 1: Creating an Active-Active IPMP Configuration

In this task, you configure an active-active IPMP group that consists of two network interfaces. (`net0` and `net1`)

1. Verify that the S11-Server1 and S11-Desktop VMs are running. If the VMs are not running, start it now.
2. Log in to the S11-Desktop VM as the `oracle` user and assume administrator privileges.
3. (Optional) Use the `ipadm` command to display the IP network interfaces that are currently configured in the system.

```
root@s11-desktop:~# ipadm show-if
IFNAME     CLASS    STATE    ACTIVE OVER
lo0        loopback ok       yes    --
net0       ip       ok       yes    --
```

Note: If you performed the previous practice, you will *not* see `net0` in this display. This step is shown here in case you perform this practice independently.

4. (Optional) If you did not delete the `net0` network interface as part of Practice 5-2, delete it now and display the results. If you have already deleted the network interface, go to step 5.

```
root@s11-desktop:~# ipadm delete-ip net0
```

Note: If you performed the previous practice, you will *not* see `net0` in this display. This step is shown here in case you perform this practice independently.

.

```
root@s11-desktop:~# ipadm show-if
IFNAME     CLASS    STATE    ACTIVE OVER
lo0        loopback ok       yes    --
```

> When configuring IPMP, you must assign all network interfaces that are attached to the same LAN to an IPMP group. In this step, you deleted the `net0` interface in preparation for configuring it in an IPMP group.

5. Rename the `net0` data link `link0_ipmp0` and the `net1` data link `link1_ipmp0`. Show the results.

```
root@s11-desktop:~# dladm rename-link net0 link0_ipmp0
root@s11-desktop:~# dladm rename-link net1 link1_ipmp0
root@s11-desktop:~# dladm show-link
LINK        CLASS     MTU    STATE      OVER
link1_ipmp0 phys      1500   unknown    --
net2        phys      1500   unknown    --
net3        phys      1500   unknown    --
link0_ipmp0 phys      1500   unknown    --
```

6. Create IP interfaces for the `link0_ipmp0` and `link1_ipmp0` data links. Show the results.

```
root@s11-desktop:~# ipadm create-ip link0_ipmp0
root@s11-desktop:~# ipadm create-ip link1_ipmp0
root@s11-desktop:~# ipadm show-if
IFNAME     CLASS    STATE    ACTIVE OVER
lo0        loopback ok       yes    --
link0_ipmp0 ip      down     no     --
link1_ipmp0 ip      down     no     --
```

7. Create an IPMP group named `ipmp0`.

```
root@s11-desktop:~# ipadm create-ipmp ipmp0
```

8. Add the `link0_ipmp0` and `link1_ipmp0` IP interfaces to the `ipmp0` IPMP group and show the results.

```
root@s11-desktop:~# ipadm add-ipmp –i link0_ipmp0 \
–i link1_ipmp0 ipmp0
root@s11-desktop:~# ipmpstat –g
GROUP     GROUPNAME  STATE   FDT     INTERFACES
ipmp0     ipmp0      ok      --      link1_ipmp0 link0_ipmp0
```

9. Assign two static IP addresses to the IPMP interface to be used for data access.

```
root@s11-desktop:~# ipadm create-addr –T static \
 –a 192.168.1.122/24 ipmp0/v4add1
root@s11-desktop:~# ipadm create-addr –T static \
 –a 192.168.1.123/24 ipmp0/v4add2
```

10. Assign a static IP address to each IPMP subinterface to be used for link testing.

```
root@s11-desktop:~# ipadm create-addr –T static \
 –a 192.168.1.142/24 link0_ipmp0/test
root@s11-desktop:~# ipadm create-addr –T static \
 –a 192.168.1.143/24 link1_ipmp0/test
```

11. Display the data and test the IP addresses.

```
root@s11-desktop:~# ipadm show-addr
ADDROBJ            TYPE     STATE        ADDR
lo0/v4             static   ok           127.0.0.1/8
link0_ipmp0/test   static   ok           192.168.1.142/24
link1_ipmp0/test   static   ok           192.168.1.143/24
ipmp0/v4add1       static   ok           192.168.1.122/24
ipmp0/v4add2       static   ok           192.168.1.123/24
lo0/v6             static   ok           ::1/128
```

12. Use the `ipmpstat` command to display the IPMP address information.

```
root@s11-desktop:~# ipmpstat -an
ADDRESS          STATE  GROUP  INBOUND     OUTBOUND
::               down   ipmp0  --          --
192.168.1.123    up     ipmp0  link1_ipmp0 link1_ipmp0 link0_ipmp0
192.168.1.122    up     ipmp0  link0_ipmp0 link1_ipmp0 link0_ipmp0
```

Note: The `INBOUND` traffic is restricted to one interface depending on the IP address that is used. The `OUTBOUND` traffic is spread across both interfaces.

13. Use the `ipmpstat` command to display the IP interface information.

```
root@s11-desktop:~# ipmpstat -i
INTERFACE   ACTIVE  GROUP       FLAGS     LINK    PROBE    STATE
link1_ipmp0 yes     ipmp0       -------   up      ok       ok
link0_ipmp0 yes     ipmp0       --mbM--   up      ok       ok
```

The interface `FLAGS` are defined as:

- `i` = Unusable due to being `INACTIVE`
- `s` = Masked `STANDBY`
- `m` = Nominated to send/receive IPv4 multicast for its IPMP group
- `b` = Nominated to send/receive IPv4 broadcast for its IPMP group
- `M` = Nominated to send/receive IPv6 multicast for its IPMP group
- `d` = Unusable due to being down
- `h` = Unusable due to being brought `OFFLINE` by `in.mpathd` (IPMP daemon) because of a duplicate hardware address

14. Use the `ipmpstat` command to display information about test address targets.

```
root@s11-desktop:~# ipmpstat -nt
INTERFACE   MODE       TESTADDR            TARGETS
link1_ipmp0 multicast  192.168.1.143       192.168.1.100
link0_ipmp0 multicast  192.168.1.142       192.168.1.100
```

Note the Sol11-Server1 IP address `192.168.1.100` under the `Targets` column. This VM should be up for you to receive this display.

15. Use the `ipmpstat` command to display the current probe information.

```
root@s11-desktop:~# ipmpstat -pn
TIME      INTERFACE   PROBE  NETRTT    RTT       RTTAVG    TARGET
0.70s     link1_ipmp0 i244   0.26ms    0.51ms    0.36ms    192.168.1.100
1.33s     link0_ipmp0 i323   0.23ms    0.43ms    0.40ms    192.168.1.100
2.25s     link1_ipmp0 i245   0.25ms    0.58ms    0.38ms    192.168.1.100
3.19s     link0_ipmp0 i324   0.22ms    0.42ms    0.40ms    192.168.1.100
3.36s     link1_ipmp0 i246   0.27ms    0.60ms    0.41ms    192.168.1.100
4.88s     link0_ipmp0 i325   0.28ms    0.37ms    0.40ms    192.168.1.100
5.30s     link1_ipmp0 i247   0.21ms    0.59ms    0.43ms    192.168.1.100
5.72s     link0_ipmp0 i326   0.38ms    0.49ms    0.41ms    192.168.1.100
6.36s     link1_ipmp0 i248   0.24ms    0.56ms    0.45ms    192.168.1.100
7.25s     link0_ipmp0 i327   0.23ms    0.42ms    0.41ms    192.168.1.100
7.81s     link1_ipmp0 i249   0.18ms    0.49ms    0.45ms    192.168.1.100
9.12s     link0_ipmp0 i328   0.25ms    0.44ms    0.41ms    192.168.1.100
9.52s     link1_ipmp0 i250   0.26ms    0.60ms    0.47ms    192.168.1.100
10.54s    link1_ipmp0 i251   0.24ms    0.60ms    0.49ms    192.168.1.100
10.56s    link0_ipmp0 i329   0.20ms    0.38ms    0.41ms    192.168.1.100
…
…
…
<Ctrl+C>
```

Your display may be different.

Task 2: Testing the Active-Active IPMP Configuration

In this task, you test the active-active IPMP configuration by causing one of the subinterfaces to fail. Then you verify that the system is still accessible by using the remaining interface.

To test the IPMP configuration, perform the following steps:

1. Log in to the S11-Desktop virtual machine as the `oracle` user and `su` to `root`.
2. Detach the network adapter of the S11-desktop VM by running the `xm network-detach` command on the `dom0` host machine.

```
# xm network-detach s11-desktop 00:16:3e:00:02:01 –f
```

Note: Verify the MAC address from the `vm.cfg` file.

3. Use the `ipmpstat` command to display IPMP group information.

```
root@s11-desktop:~# ipmpstat -g
GROUP    GROUPNAME   STATE     FDT     INTERFACES
ipmp0     ipmp0      degraded  10.00s  link0_ipmp0 [link1_ipmp0]
```

Note that `link1_ipmp0` has been boxed (`[link1_ipmp0]`) indicating that it has failed.

4. Use the `ipmpstat` command to display the IP interface information.

```
root@s11-desktop:~# ipmpstat -i
INTERFACE   ACTIVE  GROUP      FLAGS    LINK     PROBE    STATE
link1_ipmp0 no      ipmp0      -------  down     failed   failed
link0_ipmp0 yes     ipmp0      --mbM--  up       ok       ok
root@s11-desktop:~#
```

The `link1_ipmp0` interface is no longer active.

5. Use the `ipmpstat` command to display the current probe information.

```
root@s11-desktop:~# ipmpstat -pn
TIME      INTERFACE   PROBE  NETRTT    RTT       RTTAVG    TARGET
0.25s     link0_ipmp0 i343   0.81ms    0.91ms    0.68ms    192.168.0.100
1.75s     link0_ipmp0 i344   0.44ms    0.58ms    0.67ms    192.168.0.100
2.70s     link0_ipmp0 i345   0.49ms    0.71ms    0.68ms    192.168.0.100
4.46s     link0_ipmp0 i346   0.29ms    0.74ms    0.68ms    192.168.0.100
6.06s     link0_ipmp0 i347   0.60ms    0.72ms    0.69ms    192.168.0.100
7.01s     link0_ipmp0 i348   0.83ms    1.06ms    0.74ms    192.168.0.100
8.99s     link0_ipmp0 i349   0.49ms    0.72ms    0.73ms    192.168.0.100
..
..
<Ctrl+C>
root@s11-desktop:~#
```

Note that only `link0_ipmp0` is generating probes.
Your display may be different.

6. Log in to the S11-Server1 virtual machine and ping the IPMP data IP addresses configured on Sol11-Desktop.

```
root@s11-server1:~# ping 192.168.1.122
192.168.1.122 is alive
root@s11-server1:~# ping 192.168.1.123
192.168.1.123 is alive
```

7. Reboot the S11-desktop VM to reattach the network adapter. Do not use the `reboot` command. Shut down (or destroy) the VM and restart it using the `xm create` command. This is because, in order to reattach the network adapter, the `vm.cfg` file will have to be read again. Log in as the `oracle` user and then switch to the `root` user.

8. Use the `ipmpstat` command to verify that the IPMP group `ipmp0` `STATE` is `ok`.

```
root@s11-desktop:~# ipadm enable-if -t ipmp0
root@s11-desktop:~# ipmpstat –g
GROUP    GROUPNAME  STATE   FDT     INTERFACES
ipmp0    ipmp0      ok      10.00s  link1_ipmp0 link0_ipmp0
```

Task 3: Creating an Active-Standby IPMP Configuration

In this task, you reconfigure the `ipmp0` IPMP group from an active-active configuration to an active-standby configuration.

1. On the Sol11-Desktop virtual machine, display the data links.

```
root@s11-desktop:~# dladm show-link
LINK                CLASS     MTU    STATE    OVER
link1_ipmp0         phys      1500   up       --
net3                phys      1500   up  --
link0_ipmp0         phys      1500   up       --
net2                phys      1500   up  --
```

2. Rename the `net2` data link `link2_ipmp0` and show the results.

```
root@s11-desktop:~# dladm rename-link net2 link2_ipmp0
root@s11-desktop:~# dladm show-link
LINK                CLASS     MTU    STATE    OVER
link1_ipmp0         phys      1500   up       --
net3                phys      1500   up  --
link0_ipmp0         phys      1500   up       --
link2_ipmp0         phys      1500   up  --
```

3. Create an IP interface for the `link2_ipmp0` data link and show the results.

```
root@s11-desktop:~# ipadm create-ip link2_ipmp0
root@s11-desktop:~# ipadm show-if
IFNAME      CLASS    STATE    ACTIVE OVER
lo0         loopback ok       yes    --
link0_ipmp0 ip       ok       yes    --
link1_ipmp0 ip       ok       yes    --
ipmp0       ipmp     ok       yes    link0_ipmp0 link1_ipmp0
link2_ipmp0 ip       down     no     --
```

4. Add the `link2_ipmp0` IP interfaces to the `ipmp0` IPMP group and show the results.

```
root@s11-desktop:~# ipadm add-ipmp –i link2_ipmp0 ipmp0
root@s11-desktop:~# ipmpstat –g
GROUP GROUPNAME STATE FDT     INTERFACES
ipmp0 ipmp0     ok    10.00s  link2_ipmp0 link1_ipmp0 link0_ipmp0
```

Note: *If you see any error message, execute the following command.*

```
# ipadm add-ipmp –i link2_ipmp0 ipmp0
ipadm: cannot add link2_ipmp0 to ipmp0: Operation not supported
on disabled object

#ipadm enable-if -t ipmp0
```

5. Assign a static IP address to the IPMP subinterface `link2_ipmp0` to be used for link testing and show the results.

```
root@s11-desktop:~# ipadm create-addr -T static \
 -a 192.168.1.144/24 link2_ipmp0/test
root@s11-desktop:~# ipadm show-addr
ADDROBJ            TYPE     STATE  ADDR
lo0/v4             static   ok     127.0.0.1/8
ipmp0/v4add1       static   ok     192.168.1.122/24
ipmp0/v4add2       static   ok     192.168.1.123/24
link0_ipmp0/test   static   ok     192.168.1.142/24
link1_ipmp0/test   static   ok     192.168.1.143/24
link2_ipmp0/test   static   ok     192.168.1.144/24
lo0/v6             static   ok     ::1/128
```

6. Show the current setting of the `standby` property for the `link2_ipmp0` interface.

```
root@s11-desktop:~# ipadm show-ifprop -p standby link2_ipmp0
IFNAME      PROPERTY PROTO PERM CURRENT PERSISTENT DEFAULT POSSIBLE
link2_ipmp0 standby  ip    rw   off     --         off     on,off
```

Note that `standby` is currently turned off.

7. Set the `standby` property for the `link2_ipmp0` interface to `on` and show the results.

```
root@s11-desktop:~# ipadm set-ifprop -p standby=on -m ip link2_ipmp0
root@s11-desktop:~# ipadm show-ifprop -p standby link2_ipmp0
IFNAME      PROPERTY PROTO PERM CURRENT  PERSISTENT DEFAULT  POSSIBLE
link2_ipmp0 standby   ip    rw   on       on         off      on,off
```

8. Use the `ipmpstat` command to display the IPMP group information.

```
root@s11-desktop:~# ipmpstat -g
GROUP GROUPNAME STATE FDT    INTERFACES
ipmp0 ipmp0     ok    10.00s link1_ipmp0 link0_ipmp0 (link2_ipmp0)
```

Note that the `link2_ipmp0` interface is enclosed in parentheses. This indicates that the interface is set to `standby`.

9. Use the `ipmpstat` command to display the IPMP address information.

```
root@s11-desktop:~# ipmpstat -an
ADDRESS          STATE  GROUP  INBOUND     OUTBOUND
::               down   ipmp0  --          --
192.168.1.123    up     ipmp0  link1_ipmp0 link1_ipmp0 link0_ipmp0
192.168.1.122    up     ipmp0  link0_ipmp0 link1_ipmp0 link0_ipmp0
```

Note that the `link2_ipmp0` interface is not actively used for `INBOUND` and `OUTBOUND` traffic.

10. Use the `ipmpstat` command to display the IPMP interface information.

```
root@s11-desktop:~# ipmpstat -i
INTERFACE   ACTIVE  GROUP     FLAGS     LINK    PROBE     STATE
link2_ipmp0 no      ipmp0     is-----   up      ok        ok
link1_ipmp0 yes     ipmp0     -------   up      ok        ok
link0_ipmp0 yes     ipmp0     --mbM--   up      ok        ok
```

Note the flags for the `link2_ipmp0` interface. This indicates that the interface is inactive and set to `standby`.

Task 4: Testing the Active-Standby IPMP Configuration

In this task, you test the active-standby IPMP configuration by causing one of the subinterfaces to fail. Then you verify that the system is still accessible by using the remaining interface.

To test the IPMP configuration, perform the following steps:

1. Log in to the S11-Desktop VM as the `oracle` user and `su` to `root`.
2. Detach the network adapter of the S11-Server1 VM by running the `xm network-detach` command on the `dom0` host machine.

```
# xm network-detach s11-desktop 00:16:3e:00:02:01 -f
```

3. Use the `ipmpstat` command to display the IPMP group information.

```
root@s11-desktop:~# ipmpstat -g
GROUP       GROUPNAME  STATE     FDT    INTERFACES
ipmp0       ipmp0      degraded  10.00s link2_ipmp0 link0_ipmp0 [link1_ipmp0]
```

Note that `link1_ipmp0` has been boxed (`[link1_ipmp0]`), indicating that it has failed.

4. Use the `ipmpstat` command to display the IP interface information.

```
root@s11-desktop:~# ipmpstat -i
INTERFACE   ACTIVE  GROUP       FLAGS     LINK      PROBE     STATE
link2_ipmp0 yes     ipmp0       -s-----   up        ok        ok
link1_ipmp0 no      ipmp0       -------   down      failed    failed
link0_ipmp0 yes     ipmp0       --mbM--   up        ok        ok
root@s11-desktop:~#
```

The `link1_ipmp0` interface is no longer active.

5. Use the `ipmpstat` command to display the IPMP address information.

```
root@s11-desktop:~# ipmpstat -an
ADDRESS            STATE  GROUP    INBOUND     OUTBOUND
::                 down   ipmp0     --          --
192.168.1.123      up     ipmp0    link2_ipmp0 link2_ipmp0 link0_ipmp0
192.168.1.122      up     ipmp0    link0_ipmp0 link2_ipmp0 link0_ipmp0
root@s11-desktop:~#
```

6. Use the `ipmpstat` command to display the current probe information.

```
root@s11-desktop:~# ipmpstat -pn
TIME      INTERFACE   PROBE  NETRTT    RTT       RTTAVG    TARGET
0.29s     link0_ipmp0 i1659  0.64ms    1.00ms    0.64ms    192.168.1.100
0.31s     link2_ipmp0 i1115  0.40ms    0.52ms    1.15ms    192.168.1.100
1.61s     link0_ipmp0 i1660  0.74ms    0.85ms    0.67ms    192.168.1.100
2.05s     link2_ipmp0 i1116  0.42ms    0.56ms    0.52ms    192.168.1.100
2.84s     link0_ipmp0 i1661  0.29ms    0.79ms    0.68ms    192.168.1.100
3.68s     link2_ipmp0 i1117  0.28ms    0.50ms    1.07ms    192.168.1.100
4.36s     link0_ipmp0 i1662  0.32ms    0.59ms    0.67ms    192.168.1.100
5.11s     link2_ipmp0 i1118  0.40ms    0.56ms    0.52ms    192.168.1.100
5.70s     link0_ipmp0 i1663  0.85ms    1.00ms    0.71ms    192.168.1.100
6.36s     link2_ipmp0 i1119  0.47ms    0.59ms    1.01ms    192.168.1.100
```

```
7.61s     link0_ipmp0 i1664  0.32ms    0.75ms    0.72ms    192.168.1.100
7.67s     link2_ipmp0 i1120  0.32ms    0.54ms    0.53ms    192.168.1.100
…
…
<Ctrl+C>
```

Note that the `link2_ipmp0` interface is actively probing targets.
The values vary from system to system.

7. Log in to the Sol11-Server1 virtual machine and ping the IPMP data IP addresses.

```
root@s11-server1:~# ping 192.168.1.122
192.168.1.122 is alive
root@s11-server1:~# ping 192.168.1.123
192.168.1.123 is alive
```

8. Reboot the S11-desktop VM to reattach the network adapter. Do not use the `reboot` command. Shut down (or destroy) the VM and restart it using the `xm create` command. This is because, to reattach the network adapter, the `vm.cfg` file will have to be read again. Log in as the `oracle` user and then switch to the `root` user.
9. Use the `ipmpstat` command to display the IPMP group information.

```
root@s11-desktop:~# ipadm enable-if -t ipmp0
root@s11-desktop:~# ipmpstat -g
GROUP GROUPNAME STATE FDT    INTERFACES
ipmp0 ipmp0     ok    10.00s link1_ipmp0 link0_ipmp0 (link2_ipmp0)
```

Note that the `link2_ipmp0` interface has been placed back as standby and is inactive. This indicates that the failed interface is repaired.

10. Use the `ipmpstat` command to display the IPMP interface information.

```
root@s11-desktop:~# ipmpstat -i
INTERFACE   ACTIVE  GROUP       FLAGS     LINK      PROBE     STATE
link2_ipmp0 no      ipmp0       is-----   up        ok        ok
link1_ipmp0 yes     ipmp0       --mbM--   up        ok        ok
link0_ipmp0 yes     ipmp0       -------   up        ok        ok
root@s11-desktop:~#
```

Task 5: Removing the IPMP Configuration

In this task, you remove the `ipmp0` IPMP group and return the network to its original configuration.

1. Remove all the subinterfaces from the `ipmp0` IPMP group and show the results.

```
root@s11-desktop:~# ipadm remove-ipmp –i link0_ipmp0 \
–i link1_ipmp0 –i link2_ipmp0 ipmp0
root@s11-desktop:~# ipmpstat -g
GROUP   GROUPNAME   STATE    FDT     INTERFACES
ipmp0   ipmp0       failed   --      --
```

2. Delete the `ipmp0` IPMP group.

```
root@s11-desktop:~# ipadm delete-ipmp ipmp0
root@s11-desktop:~# ipmpstat –g
root@s11-desktop:~#
```

3. Display the IP address that is currently configured in the system.

```
root@s11-desktop:~# ipadm show-addr
ADDROBJ             TYPE      STATE   ADDR
lo0/v4              static    ok      127.0.0.1/8
link0_ipmp0/test    static    ok      192.168.1.142/24
link1_ipmp0/test    static    ok      192.168.1.143/24
link2_ipmp0/test    static    ok      192.168.1.144/24
lo0/v6              static    ok      ::1/128
```

4. Delete the test IP addresses and show the results.

```
root@s11-desktop:~# ipadm delete-addr link0_ipmp0/test
root@s11-desktop:~# ipadm delete-addr link1_ipmp0/test
root@s11-desktop:~# ipadm delete-addr link2_ipmp0/test
root@s11-desktop:~# ipadm show-addr
ADDROBJ             TYPE      STATE   ADDR
lo0/v4              static    ok      127.0.0.1/8
lo0/v6              static    ok      ::1/128
```

Your display may be different.

5. Delete the `link0_ipmp0`, `link1_ipmp0`, and `link2_ipmp0` IP interfaces. Show the results.

```
root@s11-desktop:~# ipadm delete-ip link0_ipmp0
root@s11-desktop:~# ipadm delete-ip link1_ipmp0
root@s11-desktop:~# ipadm delete-ip link2_ipmp0
root@s11-desktop:~# ipadm show-if
IFNAME      CLASS    STATE     ACTIVE OVER
lo0         loopback ok        yes    --
```

6. Rename the data links to their original names and show the results.

```
root@s11-desktop:~# dladm rename-link link0_ipmp0 net0
root@s11-desktop:~# dladm rename-link link1_ipmp0 net1
root@s11-desktop:~# dladm rename-link link2_ipmp0 net2
root@s11-desktop:~# dladm show-link
LINK        CLASS     MTU    STATE      OVER
net1        phys      1500   unknown    --
net2        phys      1500   unknown    --
net0        phys      1500   unknown    --
net3        phys      1500   unknown    --
```

7. Restart the svc:/network/physical:default service.

```
root@s11-desktop:~# svcadm restart svc:/network/physical:default
```

8. Verify that the `net0` network interface has been configured correctly.

```
root@s11-desktop:~# ipadm show-addr
ADDROBJ          TYPE     STATE  ADDR
lo0/v4           static   ok     127.0.0.1/8
lo0/v6           static   ok     ::1/128
```

9. Reinstate the physical network interface.

```
root@s11-desktop:~# ipadm create-ip net0
root@s11-desktop:~# ipadm create-addr –T static \
-a 192.168.1.200/24 net0/v4add1
```

10. Test the network interface by using the `ping` command.

```
root@s11-desktop:~# ping 192.168.1.100
192.168.1.100 is alive.
```

Note: Reboot the system if the `ping` command does not work.

Practices for Lesson 6: Administering Network Services

Chapter 6

Practices for Lesson 6: Overview

Practices Overview

According to your predeployment plan, it is time to evaluate the networking services.

It is important to ensure that the new operating system will support the user community's needs. Given the number of computers your company's network has to support with varying architectures and the requirement of sharing information across the network within your company, it becomes important to set up proper sharing systems and administer them regularly. With so many computers on the network, it is also important to let these computers look up IP addresses and host names of each other for various transactions.

In this practice, you will perform the following:

- Configure the Network File System (NFS).
- Configure a DNS client.
- Configure an LDAP client.

Look at your checklist to see where you are.

	Oracle Solaris 11 Predeployment Checklist
✓	Managing Services and Service Properties by Using SMF
✓	Managing Software Packages by Using IPS
✓	Managing Data Backup and Restore by Using ZFS
✓	Configuring the Network
	Administering Network Services
	Advanced Administration of Zones
	Securing the Oracle Solaris 11 OS
	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practice 6-1: Configuring the Network File System

Overview

In this practice, you configure the NFS server as well as the NFS client. You share a documentation folder from the server and access it on the client host. The following activities are covered:

- Configuring the NFS server
- Configuring the NFS client

Note: In this practice, you will configure NFS server on S11-Server1 VM and make S11-Desktop VM the NFS client.

Task 1: Configuring the NFS Server

Perform the following tasks on Sol11-Server1 VM:

1. Verify that the S11-Server1 VM machine is running.

   If not, start it now and log in as the `oracle` user. Assume administrator privileges.
2. Display the current status of the ZFS pool and the file systems.

```
root@s11-server1:~# zpool list
NAME    SIZE   ALLOC   FREE   CAP   DEDUP   HEALTH    ALTROOT
rpool  49.5G   17.2G  31.9G   35%   1.00x   ONLINE    -
root@s11-server1:~# zfs list
NAME                              USED  AVAIL  REFER  MOUNTPOINT
rpool                            12.3G  26.6G  4.64M  /rpool
rpool/ROOT                       2.89G  26.6G    31K  legacy
rpool/ROOT/solaris               2.89G  26.6G  2.51G  /
rpool/ROOT/solaris/var            334M  26.6G   128M  /var
rpool/VARSHARE                   2.53M  26.6G  2.44M  /var/share
rpool/VARSHARE/pkg                 63K  26.6G    32K  /var/share/pkg
rpool/VARSHARE/pkg/repositories    31K  26.6G    31K
/var/share/pkg/repositories
rpool/VARSHARE/zones               31K  26.6G    31K  /system/zones
rpool/dump                       1.03G  26.6G  1.00G  -
rpool/export                     7.34G  26.6G    33K  /export
rpool/export/home                 211K  26.6G    37K  /export/home
rpool/export/home/jholt            35K  26.6G    35K  /export/home/jholt
rpool/export/home/jmoose           35K  26.6G    35K  /export/home/jmoose
rpool/export/home/oracle           34K  26.6G    34K  /export/home/oracle
rpool/export/home/panna            35K  26.6G    35K  /export/home/panna
rpool/export/home/sstudent         35K  26.6G    35K  /export/home/sstudent
rpool/swap                       1.03G  26.6G  1.00G  -
…
…
```

Your display may be different. Before you create the `docs` file system, you want to make sure that it does not exist already.

3. Using the `zfs create` command, create a ZFS file system called `rpool/export/home/docs`. Confirm the creation of the file system.

```
root@s11-server1:~# zfs create rpool/export/home/docs
root@s11-server1:~# zfs list /export/home/docs
NAME                       USED  AVAIL  REFER  MOUNTPOINT
rpool/export/home/docs      31K  26.6G    31K  /export/home/docs
```

What is the mount point of `rpool/export/home/docs`? */export/home/docs*

4. Use the `touch` command to create a file called `assetlist` in `/export/home/docs`.

```
root@s11-server1:~# cd /export/home/docs
root@s11-server1:/export/home/docs# touch assetlist
root@s11-server1:/export/home/docs# cd
```

5. Use the `zfs` commands to share the ZFS file system.

```
root@s11-server1:~# zfs set \
share=name=docs,path=/export/home/docs,prot=nfs \
rpool/export/home/docs
name=docs,path=/export/home/docs,prot=nfs
root@s11-server1:~# zfs set share.nfs=on rpool/export/home/docs
root@s11-server1:~# zfs set compression=on \
rpool/export/home/docs
root@s11-server1:~# share
docs        /export/home/docs   nfs      sec=sys,rw
```

This shows that the `/export/home/docs` resource is being shared.

6. Verify that the `nfs` services are up and running.

```
root@s11-server1:~# svcs -a | grep nfs
disabled       9:13:15   svc:/network/nfs/client:default
online         9:13:15 svc:/network/nfs/fedfs-client:default
online         9:13:15 svc:/network/nfs/status:default
online         9:13:15 svc:/network/nfs/cbd:default
online         9:13:15 svc:/network/nfs/mapid:default
online         9:13:18 svc:/network/nfs/rquota:default
online         9:13:36 svc:/network/nfs/nlockmgr:default
online         9:13:37 svc:/network/nfs/server:default
```

Is `nfs/server` up and running? *Yes*

Task 2: Configuring the NFS Client

Perform the following tasks on the Sol11-Desktop VM:

1. Ensure that the S11-Server1 and S11-Desktop VMs are running.
2. Use the `dfshares` command to confirm that you can view the shared resource from the `s11-desktop` virtual machine. Create a directory called `/docs` to use as the mount point.

```
root@s11-desktop:~# dfshares s11-server1
RESOURCE                                  SERVER      ACCESS    TRANSPORT
s11-server1:/export/home/docs     s11-server1     -           -
root@s11-desktop:~# mkdir /docs
```

3. Use the `mount` command to specify the resource to be mounted on the `/docs` directory.

```
root@s11-desktop:~# mount -F nfs -o ro s11-server1:/export/home/docs \
/docs
root@s11-desktop:~# cd /docs
root@s11-desktop:/docs# ls
assetlist
```

This demonstrates that the `assetlist` file in `/export/home/docs` can be shared on S11-Desktop from S11-Server1.

Practice 6-2: Configuring a DNS Client

Overview

DNS is a hierarchically distributed naming system for systems connected to a network. It associates information with domain names assigned to each of the participating entities. Most prominently, it translates easily memorized domain names to the numerical IP addresses needed for the purpose of locating systems. DNS is an essential component of the functionality of the Internet. An often-used analogy to explain DNS is that it serves as the phone book for the Internet by translating human-friendly system host names into IP addresses.

For this practice, a DNS server has already been set up for you on S11-Server1 VM. You will configure S11-Desktop VM only as a DNS client in this practice.

Tasks

Perform the following tasks on S11-Desktop:

1. Verify that S11-Server1 and S11-Desktop VMs are running.
2. Open a new terminal in the S11-Desktop VM and run the `su -` command to assume primary administrator privileges.

```
oracle@s11-desktop:~$ su –
Password: oracle1
Oracle Corporation    SunOS 5.11     11.3       September 2015
root@s11-desktop:~#
```

3. Update the `network/dns/client` service.

```
root@s11-desktop:~# svccfg -s network/dns/client
svc:/network/dns/client> setprop config/search = astring:
("example.com")
svc:/network/dns/client> setprop config/nameserver =
net_address: (192.168.1.100)
svc:/network/dns/client> select network/dns/client:default
svc:/network/dns/client:default> refresh
svc:/network/dns/client:default> quit
```

4. Update the name service SMF. The name service switch is a configurable selection service that enables an administrator to specify the name information service or source to use for each type of network information. The services are called a database.

```
root@s11-desktop:~# svccfg -s system/name-service/switch
svc:/system/name-service/switch> setprop config/host = astring:
"files dns"
svc:/system/name-service/switch> select system/name-
service/switch:default
svc:/system/name-service/switch:default> refresh
svc:/system/name-service/switch:default> quit
```

5. Write the new information into the `/etc/resolv.conf` file.

```
root@s11-desktop:~# nscfg export svc:/network/dns/client:default
```

6. Enable the DNS client and name service.

```
root@s11-desktop:~# svcadm enable network/dns/client
root@s11-desktop:~# svcadm enable system/name-service/switch
```

7. Verify that the DNS server is able to perform host name resolution by using the `nslookup` command. This queries the DNS server.

```
root@s11-desktop:~# nslookup s11-server1.example.com
Server:             192.168.1.100
Address:            192.168.1.100#53

Name:     s11-server1.example.com
Address:  192.168.1.100
```

Observe that the DNS server, `192.168.1.100`, is able to resolve the host name, S11-Server1.

Note: You can also use the `dig` command instead of `nslookup` to query the DNS server.

Practice 6-3: Configuring an LDAP Client

Overview

LDAP is a standard application protocol for accessing and maintaining distributed directory information services over an IP network. Directory services play an important role in developing intranet and Internet applications by allowing the sharing of information about users, systems, networks, services, and applications throughout the network. As examples, directory services may provide any organized set of records, often with a hierarchical structure, such as a corporate email directory. Similarly, a telephone directory is a list of subscribers with an address and a phone number.

For this practice, an LDAP server has already been set up for you. You will configure LDAP client in this practice.

Task 1: Configuring the Client Machine

Perform the following tasks on S11-Server1 VM:

1. Create a home directory for the LDAP user `scarter`.

```
root@s11-server1:~# cd /export/home
root@s11-server1:/export/home# mkdir scarter
```

2. Add the user directory information to the `/etc/auto_home` file. This will ensure that the home directory is automounted.

```
root@ s11-server1:/export/home# pfedit /etc/auto_home

#
# Copyright 2005 Sun Microsystems, Inc.  All rights reserved.
# Use is subject to license terms.
#
# ident "%Z%%M% %I%     %E% SMI"
#
# Home directory map for automounter
#
scarter localhost:/export/home/scarter
+auto_home
~
~
:wq
```

3. Change to the `root` directory by using the `cd` command.

```
root@s11-server1:/export/home# cd
root@s11-server1:~#
```

4. Verify the domain name.

```
root@s11-server1:~# domainname
example.com
```

> If you are not able to view the domain name, run `svccfg -s network/dns/client listprop config` and verify that `example.com` is set as the domain name. Also, run the `nslookup s11-desktop.example.com` command and ensure that the DNS server is able to perform host name resolution.

5. Initialize the LDAP client by using the `ldapclient` command. This command is used to set up LDAP clients in the Solaris system. `ldapclient` assumes that the server has already been configured with the appropriate client profiles.

   Note: If you have difficulty typing and using the exact syntax of this long command, you can follow the instructions in the subsequent note.

```
root@s11-server1:~# ldapclient -v manual \
-a credentialLevel=proxy \
-a authenticationMethod=simple \
-a proxyDN=uid=proxy,dc=example,dc=com \
-a proxyPassword=oracle1 \
-a defaultServerList=192.168.1.100 \
-a defaultSearchBase=dc=example,dc=com \
-a serviceSearchDescriptor=passwd:ou=users,dc=example,dc=com?one \
-a serviceSearchDescriptor=group:ou=groups,dc=example,dc=com?one
Parsing credentialLevel=proxy
Parsing authenticationMethod=simple
Parsing proxyDN=uid=proxy,dc=example,dc=com
Parsing proxyPassword=oracle1
Parsing defaultServerList=192.168.1.100
Parsing defaultSearchBase=dc=example,dc=com
…
…
…
…
Refresh svccfg command:   /usr/sbin/svccfg -s svc:/system/name-
service/cache:default refresh
    validating pg...
Validate service properties for:   svc:/system/name-
service/cache
successful import.
import successful
start: sleep 100000 microseconds
start: sleep 200000 microseconds
start: sleep 400000 microseconds
start: system/name-service/cache:default... success
start: sleep 100000 microseconds
start: sleep 200000 microseconds
start: sleep 400000 microseconds
…
…
```

```
restart: milestone/name-services:default... success
System successfully configured
root@s11-server1:~#
```

Observation: The LDAP client has been successfully configured.

Note: The command is provided as a text file for your convenience. You can extract and copy the command to the terminal to execute it in the preceding step.

```
root@s11-server1:~# cat /opt/ora/labs/ldapclient-command-syntax.txt
```

Task 2: Testing Communication on the LDAP Server

Next, you will set the search criteria for user authentication. This enables the LDAP client to query the LDAP server.

1. Set the LDAP search host path by using the `ldapsearch` command. The `ldapsearch` utility opens a connection to an LDAP server, binds, and performs a search using a filter.

```
root@s11-server1:~# ldapsearch -h 192.168.1.100 \
-D 'cn=Manager,dc=example,dc=com' \
-b 'dc=example,dc=com' objectclass=*
Enter bind password: secret
version: 1
dn: dc=example,dc=com
o: example
objectClass: dcObject
objectClass: organization
dc: example

dn: ou=profile,dc=example,dc=com
objectClass: organizationalUnit
objectClass: top
ou: profile

dn: cn=default,ou=profile,dc=example,dc=com
objectClass: DUAConfigProfile
cn: default
defaultSearchBase: dc=example,dc=com
credentialLevel: anonymous
authenticationMethod: none
defaultSearchScope: sub
profileTTL: 300
searchTimeLimit: 60
defaultServerList: 192.168.0.100
serviceSearchDescriptor: passwd: ou=users,dc=my-domain,dc=com
serviceSearchDescriptor: shadow: ou=users,dc=my-domain,dc=com
```

```
serviceSearchDescriptor: group: ou=groups,dc=example,dc=com

dn: ou=groups,dc=example,dc=com
objectClass: organizationalUnit
objectClass: top
ou: groups

dn: cn=staff,ou=groups,dc=example,dc=com
gidNumber: 10
cn: staff
objectClass: posixGroup
objectClass: top

dn: ou=users,dc=example,dc=com
objectClass: organizationalUnit
objectClass: top
ou: users

dn: uid=scarter,ou=users,dc=example,dc=com
cn: Sam Carter
sn: Carter
givenName: Sam
uid: scarter
uidNumber: 60021
gidNumber: 10
homeDirectory: /export/home/scarter
loginShell: /bin/bash
gecos: Normal User
mail: sam.carter@example.com
shadowMax: 45
objectClass: top
objectClass: person
objectClass: inetOrgPerson
objectClass: organizationalPerson
objectClass: posixAccount
objectClass: shadowAccount
userPassword: oracle1

dn: uid=proxy,dc=example,dc=com
objectClass: account
objectClass: simpleSecurityObject
objectClass: top
```

```
userPassword: oracle1
uid: proxy
```

2. Retrieve the LDAP user password information by using the `getent` command. This command helps a user get entries from LDAP databases.

```
root@s11-server1:~# getent passwd
root:x:0:0:Super-User:/root:/usr/bin/bash
daemon:x:1:1::/:
bin:x:2:2::/usr/bin:
sys:x:3:3::/:
adm:x:4:4:Admin:/var/adm:
lp:x:71:8:Line Printer Admin:/:
uucp:x:5:5:uucp Admin:/usr/lib/uucp:
nuucp:x:9:9:uucp
Admin:/var/spool/uucppublic:/usr/lib/uucp/uucico
dladm:x:15:65:Datalink Admin:/:
netadm:x:16:65:Network Admin:/:
netcfg:x:17:65:Network Configuration Admin:/:
smmsp:x:25:25:SendMail Message Submission Program:/:
gdm:x:50:50:GDM Reserved UID:/var/lib/gdm:
zfssnap:x:51:12:ZFS Automatic Snapshots Reserved
UID:/:/usr/bin/pfsh
upnp:x:52:52:UPnP Server Reserved UID:/var/coherence:/bin/ksh
xvm:x:60:60:xVM User:/:
mysql:x:70:70:MySQL Reserved UID:/:
openldap:x:75:75:OpenLDAP User:/:
webservd:x:80:80:WebServer Reserved UID:/:
postgres:x:90:90:PostgreSQL Reserved UID:/:/usr/bin/pfksh
svctag:x:95:12:Service Tag UID:/:
unknown:x:96:96:Unknown Remote UID:/:
nobody:x:60001:60001:NFS Anonymous Access User:/:
noaccess:x:60002:60002:No Access User:/:
nobody4:x:65534:65534:SunOS 4.x NFS Anonymous Access User:/:
ikeuser:x:67:12:IKE Admin:/:
aiuser:x:61:61:AI User:/:
pkg5srv:x:97:97:pkg(5) server UID:/:
oracle:x:100:10::/export/home/oracle:/usr/bin/bash
jholt:x:60005:10:john holt:/export/home/jholt:/bin/bash
jmoose:x:60006:10:jerry moose:/export/home/jmoose:/bin/bash
panna:x:60007:10:poly anna:/export/home/panna:/bin/bash
sstudent:x:60008:10:super
student:/export/home/sstudent:/bin/bash
gail:x:60015:10::/export/home/gail:/usr/bin/bash
scarter:x:60021:10:Normal User:/home/scarter:/bin/bash
```

Observation: The information about the LDAP user, `scarter`, is coming from the LDAP server.

3. Identify the LDAP user group by using the `getent` command.

```
root@s11-server1:~# getent group
root::0:
other::1:root
bin::2:root,daemon
sys::3:root,bin,adm
adm::4:root,daemon
uucp::5:root
mail::6:root
tty::7:root,adm
lp::8:root,adm
nuucp::9:root
staff::10:
daemon::12:root
sysadmin::14:
games::20:
smmsp::25:
gdm::50:
upnp::52:
xvm::60:
netadm::65:
mysql::70:
openldap::75:
webservd::80:
postgres::90:
slocate::95:
unknown::96:
nobody::60001:
noaccess::60002:
nogroup::65534:
aiuser::61:
pkg5srv::97:
mlocate::95:
staff::10:
```

Observation: The LDAP user, `scarter`, belongs to the `staff` user group.

4. List the naming information from the LDAP server Sol11-Server1.

```
root@s11-server1:~# ldaplist
dn: ou=profile,dc=example,dc=com
```

```
dn: ou=groups,dc=example,dc=com

dn: ou=users,dc=example,dc=com

dn: uid=proxy,dc=example,dc=com
```

5. Verify that the user, `scarter`, is listed in the LDAP server.

```
root@s11-server1:~# su - scarter
Oracle Corporation   SunOS 5.11       11.3    September 2015
```

6. Identify the user and group ID information for `scarter`.

```
-bash-4.1$ id
uid=60021(scarter) gid=10(staff)
-bash-4.1$ exit
logout
root@s11-server1:~#
```

Observation: The naming information for the `scarter` user is coming from the LDAP server.

Task 3: Modifying the Network Services Switch Configuration File

While configuring the LDAP client, the LDAP configuration file overwrites the network services switch configuration file, `/etc/nsswitch.conf`. This removes the DNS entry in the `/etc/nsswitch.conf` file, which impacts DNS lookup. Therefore, you need to make the required correction in the configuration file. Remember, the `/etc/nsswitch.conf` file is used to configure the services that are to be used to determine information such as host names, password files, and group files.

1. Log in to S11-Server1 VM with the root role. Edit the `/etc/nsswitch.conf` file and modify the host's entry to look up the DNS server. Add `dns` against `hosts` and `ipnodes` as marked in the following file:

```
root@s11-server1:~# pfedit /etc/nsswitch.conf
#
# _AUTOGENERATED_FROM_SMF_V1_
#
# WARNING: THIS FILE GENERATED FROM SMF DATA.
#   DO NOT EDIT THIS FILE.  EDITS WILL BE LOST.
# See nsswitch.conf(4) for details.

passwd: files ldap
group:  files ldap
hosts:  files ldap dns
ipnodes:        files ldap dns
networks:       files ldap
protocols:      files ldap
```

```
rpc:    files ldap
ethers: files ldap
netmasks:       files ldap
bootparams:     files ldap
publickey:      files ldap
netgroup:       ldap
automount:      files ldap
aliases:        files ldap
services:       files ldap
...
...
:wq!
```

2. Run the name service configuration command to import name service resolution content from the SMF service.

```
root@s11-server1:~# nscfg import –f name-service/switch
```

3. Ping Sol11-Desktop to verify if host name resolution is taking place.

```
root@s11-server:~# ping s11-desktop
s11-desktop is alive
```

4. Verify that DNS lookup is also taking place.

```
root@s11-server1:~# nslookup s11-server1
Server:         192.168.1.100
Address:        192.168.1.100#53

Name:     s11-server1.example.com
Address: 192.168.1.100
```

Observation: DNS service is operational.

Practices for Lesson 7: Advanced Administration of Zones

Chapter 7

Practices for Lesson 7: Overview

Practices Overview

According to your predeployment plan, it is time to evaluate some of the advanced features of zones.

The key areas explored in the practices are:

- Allocating resources to zones
- Configuring Kernel zones (demonstration)
- Cloning and deploying Kernel zones by using Unified Archives (demonstration)
- Migrating an Oracle Solaris 10 Global Zone to Oracle Solaris 11

Note: Your command output displays can be different from the displays in the practice—for example, storage data, process IDs, and session-related and system-generated information.

	Oracle Solaris 11 Predeployment Checklist
✓	Managing Services and Service Properties by Using SMF
✓	Managing Software Packages by Using IPS
✓	Managing Data Backup and Restore by Using ZFS
✓	Configuring the Network
✓	Administering Network Services
	Advanced Administration of Zones
	Securing the Oracle Solaris 11 OS
	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practice 7-1: Allocating Resources to Zones

Overview

In this practice, you allocate resources to zones. To accomplish this goal, you perform the following key tasks:

- Enable services for resource pools.
- Configure a persistent resource pool.
- Bind the zone to a persistent resource pool.
- Remove the resource pool configuration.
- Manage the virtual network data flow.

Task 1: Enabling Resource Pool Services

1. Verify that the S11-Desktop VM is running.
2. Log in to the S11-Desktop VM as the `oracle` user. Use `oracle1` as the password and assume administrator privileges.
3. Verify that the `poold` daemon and the `pool` services are running.

```
root@s11-desktop:~# pgrep -lf poold
root@s11-desktop:~# svcs *pools*
STATE          STIME    FMRI
disabled       16:06:10 svc:/system/pools:default
disabled       16:05:55 svc:/system/pools/dynamic:default
```

Currently, all the pool services are disabled.

4. Verify that the `dynamic` service is dependent on the `default` pool service.

```
root@s11-desktop:~# svcs -d pools/dynamic
STATE          STIME    FMRI
disabled       16:06:10 svc:/system/pools:default
online         15:45:55 svc:/system/filesystem/local:default
```

5. Use the `svcadm` command to enable the pool services recursively. Confirm that the pool services and the `poold` daemon are up.

```
root@s11-desktop:~# svcadm enable -r pools/dynamic
root@s11-desktop:~# svcs *pools*
STATE          STIME    FMRI
online         16:08:10 svc:/system/pools:default
online         16:08:11 svc:/system/pools/dynamic:default
root@s11-desktop:~# pgrep -lf poold
 8493 /usr/lib/pool/poold
```

6. Use the `pooladm` command to display the default resource pool configuration that is currently in use.

```
root@s11-desktop:~# pooladm

system default
```

```
        string  system.comment
        int     system.version 1
        boolean system.bind-default true
        string  system.poold.objectives wt-load

        pool pool_default
                int     pool.sys_id 0
                boolean pool.active true
                boolean pool.default true
                int     pool.importance 1
                string  pool.comment
                pset    pset_default

     pset pset_default
                int     pset.sys_id -1
                boolean pset.default true
                uint    pset.min 1
                uint    pset.max 65536
                string  pset.policy minmax
                string  pset.restype cpu
                string  pset.reslist
                string  pset.units population
                uint    pset.load 1036
                uint    pset.size 2
                string  pset.comment

                cpu
                        int     cpu.sys_id 1
                        string  cpu.comment
                        string  cpu.status on-line

                cpu
                        int     cpu.sys_id 0
                        string  cpu.comment
                        string  cpu.status on-line
root@s11-desktop:~#
```

Examine the default pool and the `pset` (processer set) configuration. Also note the number of CPUs available.

Task 2: Configuring a Persistent Resource Pool

1. Verify that Sol11-Desktop VM is running.

2. Create the pool configuration file.

```
root@s11-desktop:~# ls -l /etc/pool*
/etc/pool*: No such file or directory
```

Currently, the `pooladm.conf` file does not exist.

```
root@s11-desktop:~# pooladm -s
```

Now you are saving the current pool configuration in the default file `/etc/pooladm.conf`.

```
root@s11-desktop:~# ls -l /etc/pool*
-rw-r--r-- 1 root root 1220 Sep 25 16:13 /etc/pooladm.conf
root@s11-desktop:~# file /etc/pooladm.conf
/etc/pooladm.conf:      XML document
```

The file has been created for you and it is of type XML.

3. Display the contents of the pool configuration file by using the `more` command, so that you can examine its contents one page at a time.

```
root@s11-desktop:~# more /etc/pooladm.conf
<?xml version="1.0"?>
<!DOCTYPE system PUBLIC "-//Sun Microsystems Inc//DTD Resource
Management All//EN"
"file:///usr/share/lib/xml/dtd/rm_pool.dtd.1">
<!--
Configuration for pools facility. Do NOT edit this file by hand -
use poolcfg(1) or libpool(3POOL) instead.
-->
<system ref_id="dummy" name="default" comment="" version="1"
bind-default="true">
  <property name="system.poold.objectives" type="string">wt-
load</property>
  <pool name="pool_default" active="true" default="true"
importance="1" comment="" res="pset_-1" ref_id="pool_0">
    <property name="pool.sys_id" type="int">0</property>
  </pool>
  <res_comp type="pset" sys_id="-1" name="pset_default"
default="true" min="1" max="65536" policy="minmax" restype="cpu"
reslist="" units="population" comment="" ref_id="pset_-1">
    <property name="pset.load" type="uint">372</property>
    <property name="pset.size" type="uint">2</property>
    <comp type="cpu" sys_id="1" comment="" ref_id="cpu_1">
      <property name="cpu.status" type="string">on-
line</property>
```

```
…
…

The XML file contains the default pool configuration that you saved in step 2.
```

4. Use the `poolcfg` command to display the resource pool configuration from the `config` file.

```
root@s11-desktop:~# poolcfg -c info

system default
        string  system.comment
        int     system.version 1
        boolean system.bind-default true
        string  system.poold.objectives wt-load

        pool pool_default
                int     pool.sys_id 0
                boolean pool.active true
                boolean pool.default true
                int     pool.importance 1
                string  pool.comment
                pset    pset_default
…
…
You will find that this display is exactly the same as in step 5 of the previous task. The purpose of displaying it again is that you can view it another time before you make modifications.
```

5. Create a `pset` called `pset_1to2` by using the `poolcfg` command.

```
root@s11-desktop:~# poolcfg -c 'create pset pset_1to2 \
(uint pset.min=1; uint pset.max=2)'

The pset is defined with a range of two CPUs (1–2). For instance, the kernel can use one or two CPUs based on the workload.
```

6. Use the `poolcfg` command to create a pool called `pool_gmzone` and associate it with `pset_1to2` `pset`. Confirm that the pool configuration file shows the current modification stamp.

```
root@s11-desktop:~# poolcfg -c 'create pool pool_gmzone \
(string pool.scheduler="FSS")'

While creating pool_gmzone, you also optionally indicate the Fair Share Scheduler (FSS) as your default scheduling class.

root@s11-desktop:~# poolcfg -c 'associate pool pool_gmzone \
(pset pset_1to2)'
```

```
root@s11-desktop:~# ls -l /etc/pool*
-rw-r--r-- 1 root root 1747 Sep 25 16:17 /etc/pooladm.conf
```

The pool configuration file has been modified as is evident from the time stamp.

7. Use the `poolcfg –c info` command to view the modified pool configuration.

```
root@s11-desktop:~# poolcfg -c info | more

system default
        string  system.comment
        int     system.version 1
        boolean system.bind-default true
        string  system.poold.objectives wt-load

        pool pool_default
                int     pool.sys_id 0
                boolean pool.active true
                boolean pool.default true
                int     pool.importance 1
                string  pool.comment
                pset    pset_default

        pool pool_gmzone
                boolean pool.active true
                boolean pool.default false
                string  pool.scheduler FSS
                int     pool.importance 1
                string  pool.comment
                pset    pset_1to2

        pset pset_default
                int     pset.sys_id -1
                boolean pset.default true
                uint    pset.min 1
                uint    pset.max 65536
                string  pset.policy minmax
                string  pset.restype cpu
                string  pset.reslist
                string  pset.units population
                uint    pset.load 372
                uint    pset.size 2
                string  pset.comment
```

```
                 cpu
                         int     cpu.sys_id 1
                         string  cpu.comment
                         string  cpu.status on-line

                 cpu
                         int     cpu.sys_id 0
                         string  cpu.comment
                         string  cpu.status on-line

          pset pset_1to2
                 int     pset.sys_id -2
                 boolean pset.default false
                 uint    pset.min 1
                 uint    pset.max 2
                 string  pset.policy minmax
                 string  pset.restype cpu
                 string  pset.reslist
                 string  pset.units population
                 uint    pset.load 0
                 uint    pset.size 0
                 string  pset.comment
root@s11-desktop:~#
```

This is your new pool configuration. The `pset`, the pool, and the CPUs are all associated and displayed as you had specified. Note that `pset_1to2` shows only one CPU currently. This is the minimum CPU; maximum CPUs are used as needed.

Output may slightly differ.

8. Use the `pooladm -n –c` command to validate the configuration. Commit the changes by using the `-c` option.

```
root@s11-desktop:~# pooladm -n –c
root@s11-desktop:~# pooladm -c
```

9. Using the `poolcfg –dc info` command, display the current pool configuration that is in use.

```
root@s11-desktop:~# poolcfg -dc info | more

system default
        string  system.comment
        int     system.version 1
        boolean system.bind-default true
        string  system.poold.objectives wt-load
```

```
        pool pool_gmzone
                int     pool.sys_id 1
                boolean pool.active true
                boolean pool.default false
                string  pool.scheduler FSS
                int     pool.importance 1
                string  pool.comment
                pset    pset_1to2

        pool pool_default
                int     pool.sys_id 0
                boolean pool.active true
                boolean pool.default true
                int     pool.importance 1
                string  pool.comment
…
…
```

This display should include your modifications; for instance, the `pool_gmzone` pool and its pset `pset_1to2` shown here.

10. Use the `poolstat` command to display all the active resource pools.

```
root@s11-desktop:~# poolstat -r all
 id pool                 type rid rset                  min  max size used load
  1 pool_gmzone          pset   1 pset_1to2               1    2    1 0.00 0.00
  0 pool_default         pset  -1 pset_default            1  66K    1 0.00 0.08
```

The output shows a default pool as well as your new pool.

Task 3: Binding the Zone to a Persistent Resource Pool

1. Verify that Sol11-Desktop VM is running.
2. Change to the `/opt/ora/scripts` directory and execute the `lab7_setup` script. The script creates two zones for you to use for this task. The script takes about 10 minutes to run.

```
root@s11-desktop:~# cd /opt/ora/scripts
root@s11-desktop:~# ./lab7_setup
root@s11-desktop:~# cd
```

Note: The `lab7_setup` script may take up to 20 minutes.

3. Use the `zoneadm` command to list the current state of the zones.

```
root@s11-desktop:~# zoneadm list -iv
  ID NAME             STATUS     PATH                           BRAND    IP
   0 global           running    /                              solaris  shared
   1 grandmazone      running    /zones/grandmazone             solaris  excl
```

```
   2 choczone           running    /zones/choczone           solaris   excl
```

The `choczone` and `grandmazone` zones are both up and running.

4. Because `grandmazone` needs the resource pool, allocate the pool to `grandmazone`.

```
root@s11-desktop:~# zonecfg -z grandmazone set pool=pool_gmzone
```

5. Confirm that the pool allocation is included in the zone configuration.

```
root@s11-desktop:~# zonecfg -z grandmazone info | grep pool
pool: pool_gmzone
```

The `info` suboption displays the pool that is allocated to the `grandmazone` zone.

6. Reboot `grandmazone` to activate the resource pool binding. Check whether the zone has rebooted and is currently running.

```
root@s11-desktop:~# zlogin grandmazone init 6
root@s11-desktop:~# zoneadm list -iv
  ID NAME             STATUS     PATH                           BRAND    IP
   0 global           running    /                              solaris  shared
   1 choczone         running    /zones/choczone                solaris  excl
   2 grandmazone      running    /zones/grandmazone             solaris  excl
```

Note that the reboot process might take a while to complete.

7. Log in to `grandmazone` to confirm the availability of the resource pool.

```
root@s11-desktop:~# zlogin grandmazone
[Connected to zone 'grandmazone' pts/2]
Oracle Corporation   SunOS 5.11      11.3       September 2015
```

8. Use the `poolcfg –dc info` command to view the modified pool configuration.

```
root@grandmazone:~# poolcfg -dc info
system default
        string  system.comment
        int     system.version 1
        boolean system.bind-default true
        string  system.poold.objectives wt-load

        pool pool_gmzone
                int     pool.sys_id 1
                boolean pool.active true
                boolean pool.default false
                string  pool.scheduler FSS
                int     pool.importance 1
                string  pool.comment
                pset    pset_1to2
```

```
        pset pset_1to2
                int     pset.sys_id 1
                boolean pset.default false
                uint    pset.min 1
                uint    pset.max 2
                string  pset.policy minmax
                string  pset.restype cpu
                string  pset.reslist
                string  pset.units population
                uint    pset.load 2141
                uint    pset.size 1
                string  pset.comment

                cpu
                        int     cpu.sys_id 0
                        string  cpu.comment
                        string  cpu.status on-line
root@grandmazone:~#
```

This is your new pool configuration. The `pset`, the pool, and the CPUs are all associated as you had specified.

9. Exit `grandmazone`. Log in to `choczone`.

```
root@grandmazone:~# exit
logout

[Connection to zone 'grandmazone' pts/2 closed]
root@s11-desktop:~# zlogin choczone
[Connected to zone 'choczone' pts/2]
Oracle Corporation   SunOS 5.11      11.3       June 2015
```

10. Using the `poolcfg –dc info` command, display the current pool configuration.

```
root@choczone:~# poolcfg -dc info

system default
        string  system.comment
        int     system.version 1
        boolean system.bind-default true
        string  system.poold.objectives wt-load

        pool pool_default
                int     pool.sys_id 0
                boolean pool.active true
                boolean pool.default true
```

```
                int     pool.importance 1
                string  pool.comment
                pset    pset_default

        pset pset_default
                int     pset.sys_id -1
                boolean pset.default true
                uint    pset.min 1
                uint    pset.max 65536
                string  pset.policy minmax
                string  pset.restype cpu
                string  pset.reslist
                string  pset.units population
                uint    pset.load 807
                uint    pset.size 1
                string  pset.comment

                cpu
                        int     cpu.sys_id 1
                        string  cpu.comment
                        string  cpu.status on-line
```

Because you have not modified any pool configuration here, you will see the default resource pool configuration.

11. Exit the `choczone` zone.

```
root@choczone:~# exit
```

Task 4: Removing the Resource Pool Configuration

1. Log in to the S11-Desktop VM as the `oracle` user and use `oracle1` as the password. Assume administrator privileges.
2. Remove the pool configuration from `grandmazone` by using the `zonecfg` command.

```
root@s11-desktop:~# zonecfg -z grandmazone clear pool
```

3. Reboot `grandmazone`. Check the zone to see if it is up and running.

```
root@s11-desktop:~# zlogin grandmazone init 6
root@s11-desktop:~# zoneadm list -iv
  ID NAME             STATUS     PATH                 BRAND    IP
   0 global           running    /                    solaris  shared
   2 choczone         running    /zones/choczone      solaris  excl
   3 grandmazone      running    /zones/grandmazone solaris  excl
```

4. Log in to `grandmazone`. Use the `poolcfg -dc info` command to check the resource pool configuration.

```
root@s11-desktop:~# zlogin grandmazone
```

```
[Connected to zone 'grandmazone' pts/2]
Oracle Corporation   SunOS 5.11      11.3       September 2015
root@grandmazone:~# poolcfg -dc info

system default
        string  system.comment
        int     system.version 1
        boolean system.bind-default true
        string  system.poold.objectives wt-load

        pool pool_default
                int     pool.sys_id 0
                boolean pool.active true
                boolean pool.default true
                int     pool.importance 1
                string  pool.comment
                pset    pset_default

        pset pset_default
                int     pset.sys_id -1
                boolean pset.default true
                uint    pset.min 1
                uint    pset.max 65536
                string  pset.policy minmax
                string  pset.restype cpu
                string  pset.reslist
                string  pset.units population
                uint    pset.load 2375
                uint    pset.size 1
                string  pset.comment
                cpu
                        int     cpu.sys_id 1
                        string  cpu.comment
                        string  cpu.status on-line
root@grandmazone:~#
```

Do you have any of the new resource pool information? *No, only the default resource pool configuration is available and displayed.*

5. Exit the `grandmazone` zone to return to the global zone.

```
root@grandmazone:~# exit
logout
```

```
[Connection to zone 'grandmazone' pts/2 closed]
root@s11-desktop:~#
```

Note that the resource pool configuration is kept because it will be used again in subsequent practices.

6. Halt the zones.

```
root@s11-desktop:~# zoneadm -z grandmazone halt
root@s11-desktop:~# zoneadm -z choczone halt
```

Practice 7- 2: Migrating an Oracle Solaris 10 Global Zone to Oracle Solaris 11

Overview

This practice explores the physical-to-virtual (P2V) process of migrating an Oracle Solaris 10 global zone to an Oracle Solaris 11 environment.

In this practice, you will perform the following tasks:

- Prepare the target global zone for migration.
- Migrate from the Oracle Solaris 10 global zone.

Task 1: Prepare the Target System for Migration

To prepare the target system for migration, perform the following steps in the S11-Desktop VM:

1. Create an Oracle Solaris 10 zone suitable for global zone migration.

```
root@s11-desktop:~# zonecfg -z zone2
Use 'create' to begin configuring a new zone.
zonecfg:zone2> create -t SYSsolaris10
zonecfg:zone2> set zonepath=/zones/zone2
zonecfg:zone2> set autoboot=true
zonecfg:zone2> set ip-type=shared
zonecfg:zone2> remove anet linkname=net0
zonecfg:zone2> add net
zonecfg:zone2:net> set physical=net0
zonecfg:zone2:net> set address=192.168.1.173/24
zonecfg:zone2:net> end
zonecfg:zone2> verify
zonecfg:zone2> commit
zonecfg:zone2> exit
root@s11-desktop:~#
```

2. Verify that the `zone2` configuration meets the Oracle Solaris 10 global zone migration requirements.

```
root@s11-desktop:~# zonecfg -z zone2 info
zonename: zone2
zonepath: /zones/zone2
brand: solaris10
autoboot: true
autoshutdown: shutdown
bootargs:
pool:
limitpriv:
scheduling-class:
ip-type: shared
hostid:
fs-allowed:
net:
      address: 192.168.1.173/24
      allowed-address not specified
      configure-allowed-address: true
      physical: net0
```

```
     defrouter not specified
root@s11-desktop:~#
```

Task 2: Migrate from the Oracle Solaris 10 Global Zone

Now that the target system is prepared, it is time to migrate from the Oracle Solaris 10 global zone.

To migrate the Oracle Solaris 10 global zone, perform the following steps in the S11-Desktop VM:

1. Use the `zoneadm install` subcommand to install the `flar` image in `zone2`.

   Note: `s10-server1.flar` is an Oracle Solaris 10 flash archive and it is already created for you to save time. It is available in the `/opt/ora/labs` directory.

```
root@s11-desktop:~# zoneadm -z zone2 install -a \
/opt/ora/labs/s10-server1.flar -uv
The following ZFS file system(s) have been created:
    rpool/zones/zone2
==== Starting: /usr/lib/brand/solaris10/image_install zone2 /zones/zone2 -
a/opt/ora/s10-server1.flar -u -v ====
Progress being logged to /var/log/zones/zoneadm.20150928T105824Z.zone2.install
Starting pre-installation tasks.
Pinning datasets under rpool/zones/zone2
Pinning rpool/zones/zone2
Installation started for zone "zone2"
flash archive
    Installing: This may take several minutes...
cat /dev/stdin | zfs receive -F -u -x zoned rpool/zones/zone2/installtmp/ds
Fixing properties on zone datasets
Creating /export
Activating only allowed boot environment zbe-0
Mounting boot environment in rpool/zones/zone2/rpool/ROOT/zbe-0 at
/zones/zone2/root
Preparing to mount rpool/zones/zone2/rpool/ROOT/zbe-0 at /zones/zone2/root/
Mounting rpool/zones/zone2/rpool/ROOT/zbe-0 at /zones/zone2/root/ with ZFS
temporary mount
Mounting boot environment in rpool/zones/zone2/rpool/ROOT/zbe-0 at
/zones/zone2/root (including child datasets)
Preparing to mount rpool/zones/zone2/rpool/ROOT/zbe-0 at /zones/zone2/root
Pinning datasets under rpool/zones/zone2
Pinning rpool/zones/zone2
Pinning rpool/zones/zone2/rpool
Pinning rpool/zones/zone2/rpool/ROOT
Pinning rpool/zones/zone2/rpool/ROOT/zbe-0
Pinning rpool/zones/zone2/rpool/ROOT/zbe-0@zflash.150910.09.34.33
Pinning rpool/zones/zone2/rpool/ROOT/zbe-0@zflash.150910.09.39.35
Pinning rpool/zones/zone2/rpool/export
Pinning rpool/zones/zone2/rpool/export/home
Mounting boot environment in rpool/zones/zone2/rpool/ROOT/zbe-0 at
/zones/zone2/root (including child datasets)
...
...
...
```

```
==== Completed: /usr/lib/brand/solaris10/image_install zone2 /zones/zone2 -
a/opt/ora/s10-server1.flar -u -v  ====
Log saved in non-global zone as
/zones/zone2/root/var/log/zones/zoneadm.20150928T105824Z.zone2.install
root@s11-desktop:~#
```

Note: This will take time to complete. While installing the zone, you must use either the `-p` option or the `-u` option. If you do not specify one of these two options, an error results. The `-p` option preserves the system identity and `-u` option unconfigures the system.

2. List the zones currently configured on the system.

```
root@s11-desktop:~# zoneadm list -cv
  ID NAME             STATUS     PATH                   BRAND      IP
   0 global           running    /                      solaris    shared
   1 grandmazone      installed  /zones/grandmazone     solaris    excl
   2 choczone         installed  /zones/choczone        solaris    excl
   - zone2            installed  /zones/zone2           solaris10  shared
```

3. Boot the newly migrated zone.

```
root@s11-desktop:~# zoneadm -z zone2 boot
```

4. List the zones to verify that `zone2` has successfully booted.

```
root@s11-desktop:~# zoneadm list -cv
  ID NAME             STATUS     PATH                   BRAND      IP
   0 global           running    /                      solaris    shared
   4 zone2            running    /zones/zone2           solaris10  shared
   - grandmazone      installed  /zones/grandmazone     solaris    excl
   - choczone         installed  /zones/choczone        solaris    excl
```

5. Configure the zone and log in to the `zone2` console.

```
root@s11-desktop:~# zlogin -C zone2
...
```

Note: The system configuration utility may direct you to use the F2 or ESC + 2 keys to move to the next step in the installation process. If F2 key does not work, try using the combination of ESC + 2 keys. Use the Tab key to select options. If the up and down arrow keys do not work, try using the CTRL + N and CTRL + P keys to move to the next or previous item for selection.

Use the following parameters when performing the initial system configuration:

- Terminal type: `DEC VT100`
- Hostname: `zone2`
- Configure Kerberos Security: No
- Name Service: `None`
- NFSv4 Domain Name: `Use the NFSv4 domain derived by the system`
- Time Zone: *Set as per your preference*
- Root password: `oracle1`

```
zone2 console login: root
Password: oracle1
...
...
Oracle Corporation   SunOS 5.10     Generic Patch        January 2005
```

6. Verify the operating system environment.

```
# cat /etc/release
                    Oracle Solaris 10 1/13 s10x_u11wos_24a X86
  Copyright (c) 1983, 2013, Oracle and/or its affiliates. All rights reserved.
                            Assembled 17 January 2013
# hostname
zone2
# uname -r
5.10
# uname -a
SunOS zone2 5.10 Generic_Virtual i86pc i386 i86pc
```

7. Determine the zone's network interface and IP configuration.

```
# ifconfig -a
lo0:1: flags=2001000849<UP,LOOPBACK,RUNNING,MULTICAST,IPv4,VIRTUAL> mtu 8232
index 1
        inet 127.0.0.1 netmask ff000000
net0:1: flags=100001000843<UP,BROADCAST,RUNNING,MULTICAST,IPv4,PHYSRUNNING>
mtu 1500 index 2
        inet 192.168.1.173 netmask ffffff00 broadcast 192.168.1.255
lo0:1: flags=2002000849<UP,LOOPBACK,RUNNING,MULTICAST,IPv6,VIRTUAL> mtu 8252
index 1
        inet6 ::1/128
```

8. Move back into the global zone.

```
# exit


[Connection to zone 'zone2' pts/2 closed]
```

9. Halt the `zone2` zone.

```
root@s11-desktop:~# zoneadm –z zone2 halt
```

10. Close the terminal window.

Practice 7-3: Configuring Kernel Zones (Demonstration)

Overview

Kernel zone is a feature enhancement that extends the functionality of the existing zones technology. The Oracle Solaris Kernel Zones feature provides a full kernel and user environment within a zone, and also increases kernel separation between the host and the zone.

This demonstration is provided to help you understand the working of the feature. In the demonstration, you can observe how to:

- Configure and install a Kernel zone
- Clone a Kernel zone
- Warm migrate a Kernel zone

Note: Before viewing the demonstration file, it is necessary that you understand the detailed procedure documented in the "Configuring Kernel Zones" section of the Student Guide.

Assumptions

Adobe Flash Player is already installed on the host machine before executing the demonstration.

Special note for playing the demonstration in the virtual machine:

- To be able to view demo controls in the browser, it is recommended to switch to full screen.
- To switch to full-screen mode in the browser window, go to **View** > **Full Screen**.

Tasks

Perform the following steps on your host machine:

1. On your host machine, open a terminal window.
2. Change to the `/opt/ora/demo/Kernel_Zones` directory.

```
# cd /opt/ora/demo/Kernel_Zones
# ls
Configuring_Kernel_Zones_on_SPARC.htm
Configuring_Kernel_Zones_on_SPARC.swf
standard.js
```

3. Open the `Configuring_Kernel_Zones_on_SPARC.htm` file in a web browser.

```
# firefox Configuring_Kernel_Zones_on_SPARC.htm &
```

4. A browser window with the Flash demo is displayed.
5. Close the terminal window.
6. Close the web browser after you complete viewing the flash demo.

Practice 7-4: Working with Unified Archives (Demonstration)

Overview

Oracle Solaris Unified Archives are a new native archive type for Oracle Solaris. Unified Archives allow for multiple system instances to be archived in a single unified file format. Unified Archives may contain one or more archived instances of Oracle Solaris OS from a single host. An OS instance may be a global zone, a non-global zone, or a kernel zone. These individual systems may be archived independently or bundled together. They may also be selectively archived, so that an archive may contain only one zone or a selection of zones.

Note: Before viewing the demonstration file, it is necessary that you understand the detailed procedure documented in the "Working with Unified Archives" section of the Student Guide.

Assumptions

Adobe Flash Player is already installed on the host machine before executing the demonstration.

Special note for playing the demonstration in the virtual machine:

- To be able to view demo controls in the browser, it is recommended to switch to full screen.
- To switch to full-screen mode in the browser window, go to **View** > **Full Screen**.

Tasks

Perform the following steps on your host machine:

1. On your host machine, open a terminal window.
2. Change to the `/opt/ora/demo/Unifed_Archives` directory.

```
# cd /opt/ora/demo/Unified_Archives
# ls
standard.js
Using_UA_to_Deploy_KZ.htm
Using_UA_to_Deploy_KZ.swf
```

3. Open the `Using_UA_to_Deploy_KZ.htm` file in a web browser.

```
# firefox Using_UA_to_Deploy_KZ.htm &
```

4. A browser window with the Flash demo is displayed.
5. Close the terminal window.
6. Close the web browser after you complete viewing the flash demonstration.

Practices for Lesson 8: Securing the Oracle Solaris 11 OS

Chapter 8

Practices for Lesson 8: Securing the Oracle Solaris 11 OS

Practices Overview

In these practices, you will be presented with a plan for securing the Oracle Solaris 11 OS by using privileges, RBAC, BART, and compliance.

According to the predeployment test plan, you are asked to assess the user, process, program privileges, and system. First, you determine the available privileges and for various situations you determine the required privileges. Similarly, you will create new roles and the rights profiles. In addition, you will assign the roles, profiles, and authorizations to current and new users. You also establish the RBAC policy. The key areas explored in the practices are:

- Delegating privileges to users and processes
- Configuring role-based access control (RBAC)
- Monitoring and restricting the superuser (`su` log)
- Verifying file integrity by using BART
- Assessing the compliance of an Oracle Solaris system

Note: Your command output displays may be different from the displays in the practice. Some examples would be storage, process IDs, and session and system-generated information.

Now you check your progress. You just completed administering zones and are now working with securing the Oracle Solaris 11 OS

	Oracle Solaris 11 Predeployment Checklist
✓	Managing Services and Service Properties by Using SMF
✓	Managing Software Packages by Using IPS
✓	Managing Data Backup and Restore by Using ZFS
✓	Configuring the Network
✓	Administering Network Services
✓	Advanced Administration of Zones
	Securing the Oracle Solaris 11 OS
	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practice 8-1: Delegating Privileges to Users and Processes

Overview

As part of the predeployment testing plan, you are tasked with managing privileges for users and processes. In this practice, you work in the following areas:

- Examining process privileges
- Managing user privileges

Task 1: Examining Process Privileges

This task covers the following activities:

- Determining the privileges on a process
- Determining privileges needed by a program
- Displaying the description of a privilege

1. Verify that the S11-Desktop VM is running.
2. Log in to the S11-Desktop VM as the `oracle` user and use the password `oracle1`. Assume administrative privileges.
3. Use the `ppriv` command to view the privileges for the current shell.

```
root@s11-desktop:~# ps
  PID TTY         TIME CMD
1644  pts/1       0:00 ps
1549  pts/1       0:00 bash
1548  pts/1       0:00 su
root@s11-desktop:~# ppriv $$
1549: -bash
flags = <none>
    E: all
    I: basic
    P: all
    L: all
```

What does the `$$` symbol represent? It represents the *current shell, which is `bash`.*

Do you know what the `E`, `I`, `P`, and `L` privilege sets are? *`E` for effective, `I` for inherited, `P` for permitted, and `L` for limit sets.*

4. Use the `ppriv –v` command to view the privileges.

```
root@s11-desktop:~# ppriv -v $$ | more
1549: -bash
flags = <none>
    E:
contract_event,contract_identity,contract_observer,cpc_cpu,dtrac
e_kernel,dtrace_proc,dtrace_user,file_chown,file_chown_self,file
_dac_execute,file_dac_read,file_dac_search,file_dac_write,file_d
owngrade_sl,file_flag_set,file_link_any,file_owner,file_read,fil
```

```
e_setid,file_upgrade_sl,file_write,graphics_access,graphics_map,
ipc_dac_read,ipc_dac_write,ipc_owner,net_access,net_bindmlp,net_
icmpaccess,net_mac_aware,net_mac_implicit,net_observability,net_
privaddr,net_rawaccess,proc_audit,proc_chroot,proc_clock_highres
,proc_exec,proc_fork,proc_info,proc_lock_memory,proc_owner,proc_
priocntl,proc_session,proc_setid,proc_taskid,proc_zone,sys_acct,
sys_admin,sys_audit,sys_config,sys_devices,sys_dl_config,sys_flo
w_config,sys_ib_config,sys_ib_info,sys_ip_config,sys_ipc_config,
sys_iptun_config,sys_linkdir,sys_mount,sys_net_config,sys_nfs,sy
s_ppp_config,sys_res_bind,sys_res_config,sys_resource,sys_share,
sys_smb,sys_suser_compat,sys_time,sys_trans_label,win_colormap,w
in_config,win_dac_read,win_dac_write,win_devices,win_dga,win_dow
ngrade_sl,win_fontpath,win_mac_read,win_mac_write,win_selection,
win_upgrade_sl
    I:
file_link_any,file_read,file_write,net_access,proc_exec,proc_for
k,proc_info,proc_session,sys_ib_info
P:
contract_event,contract_identity,contract_observer,cpc_cpu,dtrac
e_kernel,dtrace_proc,dtrace_user,file_chown,file_chown_self,file
_dac_execute,file_dac_read,file_dac_search,file_dac_write,file_d
owngrade_sl,file_flag_set,file_link_any,file_owner,file_read,fil
e_setid,file_upgrade_sl,file_write,graphics_access,graphics_map,
ipc_dac_read,ipc_dac_write,ipc_owner,net_access,net_bindmlp,net_
icmpaccess,net_mac_aware,net_mac_implicit,net_observability,net_
privaddr,net_rawaccess,proc_audit,proc_chroot,proc_clock_highres
,proc_exec,proc_fork,proc_info,proc_lock_memory,proc_owner,proc_
priocntl,proc_session,proc_setid,proc_taskid,proc_zone,sys_acct,
sys_admin,sys_audit,sys_config,sys_devices,sys_dl_config,sys_flo
w_config,sys_ib_config,sys_ib_info,sys_ip_config,sys_ipc_config,
sys_iptun_config,sys_linkdir,sys_mount,sys_net_config,sys_nfs,sy
s_ppp_config,sys_res_bind,sys_res_config,sys_resource,sys_share,
sys_smb,sys_suser_compat,sys_time,sys_trans_label,win_colormap,w
in_config,win_dac_read,win_dac_write,win_devices,win_dga,win_dow
ngrade_sl,win_fontpath,win_mac_read,win_mac_write,win_selection,
win_upgrade_sl
    L:
contract_event,contract_identity,contract_observer,cpc_cpu,dtrac
e_kernel,dtrace_proc,dtrace_user,file_chown,file_chown_self,file
_dac_execute,file_dac_read,file_dac_search,file_dac_write,file_d
owngrade_sl,file_flag_set,file_link_any,file_owner,file_read,fil
e_setid,file_upgrade_sl,file_write,graphics_access,graphics_map,
ipc_dac_read,ipc_dac_write,ipc_owner,net_access,net_bindmlp,net_
icmpaccess,net_mac_aware,net_mac_implicit,net_observability,net_
privaddr,net_rawaccess,proc_audit,proc_chroot,proc_clock_highres
,proc_exec,proc_fork,proc_info,proc_lock_memory,proc_owner,proc_
priocntl,proc_session,proc_setid,proc_taskid,proc_zone,sys_acct,
sys_admin,sys_audit,sys_config,sys_devices,sys_dl_config,sys_flo
w_config,sys_ib_config,sys_ib_info,sys_ip_config,sys_ipc_config,
sys_iptun_config,sys_linkdir,sys_mount,sys_net_config,sys_nfs,sy
s_ppp_config,sys_res_bind,sys_res_config,sys_resource,sys_share,
sys_smb,sys_suser_compat,sys_time,sys_trans_label,win_colormap,w
```

```
in_config,win_dac_read,win_dac_write,win_devices,win_dga,win_dow
ngrade_sl,win_fontpath,win_mac_read,win_mac_write,win_selection,
win_upgrade_sl
```

Using the `-v` option, you get a wealth of information.

5. Determine the process ID of the `mapid` daemon by using the `pgrep` command.

```
root@s11-desktop:~# pgrep -fl mapid
  686 /usr/lib/nfs/nfsmapid
```

What is the PID of the `mapid` daemon? *686*

Do you know the function of `mapid`? *It is one of the NFS daemons and exchanges user or group identifiers between the NFS client and server.*

Note: If the above process is not available, use `lockd` instead of `mapid`.

6. Use the `ppriv` command by using the PID.

```
root@s11-desktop:~# ppriv -v 686
686: /usr/lib/nfs/nfsmapid
flags = PRIV_AWARE
     E:
dax_access,file_read,file_write,net_access,proc_exec,proc_fork,p
roc_info,sys_ib_info,sys_nfs
     I: none
     P:
file_read,file_write,net_access,proc_exec,proc_fork,proc_info,sy
s_ib_info,sys_nfs
     L: none
```

Notice that the `mapid` process is `PRIV_AWARE`.

What is the significance of the `PRIV_AWARE` flag? *The process is able to reduce its privileges*.

7. Repeat step 5, this time without the `–v` option.

```
root@s11-desktop:~# ppriv 686
686: /usr/lib/nfs/lockd
flags = PRIV_AWARE
     E: basic,!file_link_any,!proc_session,sys_nfs
     I:
basic,!dax_access,!file_link_any,!file_read,!file_write,!net_acc
ess,!proc_exec,!proc_fork,!proc_info,!proc_session,!sys_ib_info
     P: basic,!file_link_any,!proc_session,sys_nfs
     L:
basic,!file_link_any,!file_read,!file_write,!net_access,!proc_ex
ec,!proc_fork,!proc_info,!proc_session,!sys_ib_info
```

Determine the two differences between the outputs in the two steps.

a) The `-v` option displays summarized output (not verbose).
b) With no `-v` option, the `ppriv` command also displays the disallowed privileges.

8. Using the `ppriv -vl` command, display the privilege definition.

```
root@s11-desktop:~# ppriv -vl file_link_any
file_link_any
    Allows a process to create hardlinks to files owned by a
uid different from the process' effective uid.
```

Now you have it. Try to display the definition of another privilege. Would this command work for any privileges? *Yes.*

Task 2: Managing User Privileges

This task covers the following activities:

- Determining the privilege needed by a user
- Debugging the privileges
- Assigning privileges to a user/role
- Limiting privileges of a user/role
- Determining the privileged commands you can use

Task 2A: Using the File Ownership Privilege

This task covers the following activities:

- Determining the privilege needed by a user
- Debugging the privileges
- Assigning privileges to a user/role

1. Verify that the S11-Desktop VM is running.
2. Verify that the users `jholt` and `jmoose` have user accounts. These accounts will be used for working with the privileges.

```
root@s11-desktop:~# getent passwd | grep jholt
jholt:x:60005:10:john holt:/export/home/jholt:/bin/bash
root@s11-desktop:~# getent passwd | grep jmoose
jmoose:x:60006:10:jerry moose:/export/home/jmoose:/bin/bash
root@s11-desktop:~#
```

3. Use the `su – jmoose` command to switch to `jmoose`'s account. Create a directory called `docs`. Then exit to the administrator account.

```
root@s11-desktop:~# su - jmoose
Oracle Corporation    SunOS 5.11     11.3       September 2015
jmoose@s11-desktop:~$ pwd
/export/home/jmoose
jmoose@s11-desktop:~$ mkdir docs
jmoose@s11-desktop:~$ ls -ld /export/home/jmoose/docs
```

```
drwxr-xr-x   2 jmoose   staff          2 Sep 28 03:00
/export/home/jmoose/docs
jmoose@s11-desktop:~$ exit
logout
root@s11-desktop:~#
```

Because `jmoose` created the `docs` directory, he is the owner.

4. Use the `su – jholt` command to switch to `jholt`'s account.

```
root@s11-desktop:~# su - jholt
Oracle Corporation    SunOS 5.11     11.3       September 2015
jholt@s11-desktop:~$
```

The reasons for logging in as `jholt` are:

a) To determine the privileges needed by `jholt`

b) To grant him the privileges as the administrative user

5. Check your privileges as the `jholt` account. Then use the `ls –ld` command to display the owner of the `docs` directory in `jmoose`'s home directory.

```
jholt@s11-desktop:~$ id
uid=60005(jholt) gid=10(staff)
jholt@s11-desktop:~$ ppriv $$
1681:  -bash
flags = <none>
     E: basic
     I: basic
     P: basic
     L: all
```

Because you are logged in as `jholt`, the current process shows your privileges, which could be different for different accounts based on the privileges granted by the system administrator.

Why would you want to use the `-v` option with this command? *Issue the command and analyze the difference. Refer to Task 1 if you need help.*

```
jholt@s11-desktop:~$ ls -ld /export/home/jmoose/docs
drwxr-xr-x   2 jmoose   staff          2 Sep 28 03:00
/export/home/jmoose/docs
jholt@s11-desktop:~$
```

Before you change the ownership of the `docs` directory in `jmoose`'s home directory, you want to make sure that `jmoose` is the owner.

6. As the `jholt` user, use the `chown` command to change the ownership of the `docs` directory to `jholt`.

```
jholt@s11-desktop:~$ chown jholt /export/home/jmoose/docs
chown: /export/home/jmoose/docs: Not owner
```

As expected, because `jholt` does not have the privilege to execute the `chown` command, a message is displayed.

7. Use the `ppriv` command in debug mode to determine what privilege is missing.

```
jholt@s11-desktop:~$ ppriv -eD chown jholt \
/export/home/jmoose/docs
chown[1692]: missing privilege "file_chown" (euid = 60005,
syscall = "fchownat") for "/export/home/jmoose/docs" at
zfs_setattr+0xc6c
chown: /export/home/jmoose/docs: Not owner
```

Can you tell which privilege is needed by `jholt`? *The `file_chown` privilege. The `-D` option is for debugging.*

8. Use the `truss` command to determine what privilege is missing.

```
jholt@s11-desktop:~$ truss chown jholt /export/home/jmoose/docs
execve("/usr/bin/chown", 0xF66F8A30, 0xF66F8A40)  argc = 3
sysinfo(SI_MACHINE, "i86pc", 257)         = 6
mmap(0x00000000, 32, PROT_READ|PROT_WRITE, MAP_PRIVATE|MAP_ANON,
-1, 0) = 0xEF470000
memcntl(0xEF474000, 35608, MC_ADVISE, MADV_WILLNEED, 0, 0) = 0
mmap(0x00000000, 4096, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANON, -1, 0) = 0xEF460000
memcntl(0x08050000, 3740, MC_ADVISE, MADV_WILLNEED, 0, 0) = 0
resolvepath("/usr/bin/chown", "/usr/bin/chown", 1023) = 14
resolvepath("/usr/lib/ld.so.1", "/lib/ld.so.1", 1023) = 12
stat64("/usr/bin/chown", 0xF66F85F0)      = 0
open("/var/ld/ld.config", O_RDONLY)       Err#2 ENOENT
sysconfig(_CONFIG_PAGESIZE)               = 4096
stat64("/lib/libc.so.1", 0xF66F7DC0)      = 0
resolvepath("/lib/libc.so.1", "/lib/libc.so.1", 1023) = 14
open("/lib/libc.so.1", O_RDONLY)          = 3
mmapobj(3, MMOBJ_INTERPRET, 0xEF460770, 0xF66F7E2C, 0x00000000)
= 0
close(3)                        = 0
mmap(0x00000000, 12288, PROT_READ|PROT_WRITE,
MAP_PRIVATE|MAP_ANON, -1, 0) = 0xEF2D0000
memcntl(0xEF2E0000, 223888, MC_ADVISE, MADV_WILLNEED, 0, 0) = 0
mmap(0x00010000, 24576, PROT_READ|PROT_WRITE|PROT_EXEC,
MAP_PRIVATE|MAP_ANON|MAP_ALIGN, -1, 0) = 0xEF2C0000
```

```
...
...
...
lstat64("/export/home/jmoose/docs", 0x08063010) = 0
chown("/export/home/jmoose/docs", 60005, -1)    Err#1 EPERM
[file_chown]
fstat64(2, 0xF66F7960)                         = 0
chown: write(2, " c h o w n :  ", 7)            = 7
open("/usr/lib/locale/en_US.UTF-
8/LC_MESSAGES/SUNW_OST_OSLIB.mo", O_RDONLY) Err#2 ENOENT
/export/home/jmoose/docswrite(2, " / e x p o r t / h o m e"..,
24) = 24
: write(2, " :  ", 2)                          = 2
Not ownerwrite(2, " N o t   o w n e r", 9)      = 9

write(2, "\n", 1)                         = 1
_exit(1)
```

The `truss` utility is also used for debugging purposes. As you see, this utility also reports that the `file_chown` privilege is missing (although not in plain English text).

9. Exit the `jholt` account and, as the administrator, use the `usermod` command to grant `jholt` the `file_chown` privilege. Confirm the entry in the `/etc/user_attr` file.

```
jholt@s11-desktop:~$ exit
logout
root@s11-desktop:~# usermod –K defaultpriv=basic,file_chown \
jholt
root@s11-desktop:~# getent user_attr | grep jholt
jholt::::defaultpriv=basic,file_chown
```

Here you have granted `jholt` the `file_chown` privilege. Note that you are only interested in granting him the `file_chown` privilege, but you must include the basic privilege also because the `defaultpriv` keyword will replace all his privileges with the specified privileges. This file is used to record any special privileges to users or roles. This facility is covered in detail in the next practice.

10. Log in again to `jholt`'s account. Now issue that `chown` command. Confirm the ownership of the `docs` directory.

```
root@s11-desktop:~# su - jholt
Oracle Corporation    SunOS 5.11     11.3       September 2015
jholt@s11-desktop:~$ chown jholt /export/home/jmoose/docs
jholt@s11-desktop:~$ ls -ld /export/home/jmoose/docs
drwxr-xr-x   2 jholt    staff          2 Sep 28 03:00
/export/home/jmoose/docs
```

Success! You were able to successfully change the ownership to `jholt`.

Return the ownership of the `docs` directory to `jmoose`, so that you can use this setup again.

```
jholt@s11-desktop:~$ chown jmoose /export/home/jmoose/docs
jholt@s11-desktop:~$ ls -ld /export/home/jmoose/docs
drwxr-xr-x   2 jmoose   staff          2 Sep 28 03:00
/export/home/jmoose/docs
```

Task 2B: Limiting the Privileges of a User

The following activities are covered in this task:

- Limiting the privileges of a user
- Determining the privileged commands you can use

1. In the `jholt` account, use the `ps -ef` command to display the current processes.

```
jholt@s11-desktop:~$ ps -ef | more
     UID   PID  PPID   C    STIME TTY         TIME CMD
    root     0     0   0 08:51:16 ?           0:04 sched
    root     5     0   0 08:51:15 ?           0:05 zpool-rpool
    root     6     0   0 08:51:17 ?           0:02 kmem_task
    root     1     0   0 08:51:17 ?           0:00
/usr/sbin/init
    root     2     0   0 08:51:17 ?           0:00 pageout
    root     3     0   0 08:51:17 ?           0:05 fsflush
    root     7     0   0 08:51:17 ?           0:00 intrd
    root     8     0   0 08:51:17 ?           0:00 vmtasks
    root     9     0   0 08:51:17 ?           0:00 postwaittq
  netadm    61     1   0 08:51:38 ?           0:00
/lib/inet/ipmgmtd
    root    13     1   0 08:51:19 ?           0:12
/lib/svc/bin/svc.startd
    root    15     1   0 08:51:19 ?           0:36
/lib/svc/bin/svc.configd
    root   204     1   0 08:51:49 ?           0:00
/usr/lib/rad/rad -sp
```

```
  oracle  1452  1381   0 08:54:11 ?           0:01 gnome-power-
manager
  daemon   679     1   0 08:52:33 ?           0:00
/usr/sbin/rpcbind
  netcfg    46     1   0 08:51:32 ?           0:00
/lib/inet/netcfgd
   dladm    57     1   0 08:51:36 ?           0:02
/usr/sbin/dlmgmtd
    root   263     1   0 08:51:54 ?           0:00
/usr/lib/pfexecd
    root   140     1   0 08:51:47 ?           0:00
/usr/lib/dbus-daemon --system
  daemon    67     1   0 08:51:38 ?           0:00
/lib/crypto/kcfd
    root    87     1   0 08:51:41 ?           0:00
/lib/inet/in.mpathd
…
…
…
```

The output may vary from system to system.

At this time, with the current privileges, are you able to view any processes started by others? *Yes.*

2. Exit the `jholt` account and, as the administrator, launch a Korn shell and use the `usermod` command to limit `jholt`'s privileges.

```
jholt@s11-desktop:~$ exit
logout
root@s11-desktop:~# ps
  PID TTY         TIME CMD
1728 pts/1       0:00 ps
1549 pts/1       0:00 bash
1548 pts/1       0:00 su
root@s11-desktop:~# usermod -K defaultpriv=basic,!proc_info \
jholt
-bash: !proc_info: event not found
```

As the message says, the bash shell is not aware of the `!proc_info event`. Switch to `ksh`.

```
root@s11-desktop:~# ksh
root@s11-desktop:~# ps
 PID TTY         TIME CMD
1729 pts/1       0:00 ksh
1549 pts/1       0:00 bash
1732 pts/1       0:00 ps
```

```
1548 pts/1       0:00 su
root@s11-desktop:~# usermod -K defaultpriv=basic,!proc_info \
jholt
root@s11-desktop:~# getent user_attr | grep jholt
jholt::::defaultpriv=basic,!proc_info
```

Exit to Bash shell, which is your default shell.

```
root@s11-desktop:~# exit
root@s11-desktop:~# ps
 PID TTY         TIME CMD
1739 pts/1       0:00 ps
1549 pts/1       0:00 bash
1548 pts/1       0:00 su
```

You have taken away the process view privilege from `jholt`. Can you tell if he can display the processes for other users? *No.*

3. Return to the `jholt` account and use the `ps –ef` command to display the current processes.

```
root@s11-desktop:~# su - jholt
Oracle Corporation    SunOS 5.11     11.3       September 2015
jholt@s11-desktop:~$ ps -ef
     UID   PID  PPID   C    STIME TTY         TIME CMD
   jholt  1741  1740   0 04:34:45 pts/2       0:00 -bash
   jholt  1745  1741   0 04:34:49 pts/2       0:00 ps -ef
jholt@s11-desktop:~$
```

Are you able to view processes for other users? *No.*

Why? *Because the administrator has taken away the `proc_info` privilege*

Did you remember to log back in to `jholt`'s account? *Yes.*

Why? *To make the new privileges effective*

How would you find out if `jholt` still has the privilege to execute the `chown` command? *Issue the `chown` command on a file as demonstrated earlier or check `jholt`'s privileges.*

4. Exit the `jholt` account and as the administrator, replace the original privileges for the `jholt` account.

```
jholt@s11-desktop:~$ exit
logout
root@s11-desktop:~# usermod -K defaultpriv=basic jholt
root@s11-desktop:~# getent user_attr | grep jholt
jholt::::defaultpriv=basic
```

Now John Holt should be able to use all the privileges included in the basic rights profile. You will learn more about profiles in the next practice.

Can you determine the privileges included in the basic privilege set? *Yes, use the `ppriv` command.*

5. Now you are curious. You want to know what privileges John Holt has. As John Holt, use the commands `profiles`, `roles`, and `auths` to view the privileges.

```
root@s11-desktop:~# su - jholt
Oracle Corporation    SunOS 5.11      11.3       September 2015
jholt@s11-desktop:~$ profiles
Basic Solaris User
All
jholt@s11-desktop:~$ roles
No roles
jholt@s11-desktop:~$ auths
solaris.admin.wusb.read,solaris.mail.mailq,solaris.network.autoc
onf.read
```

If any special profiles, roles, or individual authorizations are assigned to John Holt, they will be displayed here.

These facilities are part of Role-Based Access Control, which will be covered in the next practice.

6. Use the `profiles –l` command to see more details of the privileges assigned to John Holt.

```
jholt@s11-desktop:~$ profiles -l
Basic Solaris User
    auths=solaris.mail.mailq, solaris.admin.wusb.read
    profiles=All
          /usr/bin/cdrecord.bin
privs=file_dac_read,sys_devices,proc_lock_memory,proc_priocntl,n
et_privaddr
          /usr/bin/readcd.bin
privs=file_dac_read,sys_devices,net_privaddr
          /usr/bin/cdda2wav.bin
privs=file_dac_read,sys_devices,proc_priocntl,net_privaddr
All
          *
```

These are the same profiles you displayed in the previous step. However, the privileges connected to the profiles are also displayed.

Exit the `jholt` account.

```
jholt@s11-desktop:~$ exit
logout
root@s11-desktop:~#
```

Practice 8-2: Configuring Role-Based Access Control

Overview

Your predeployment test plan calls for using the Role-Based Access Control (RBAC) functionality of Oracle Solaris 11. By using RBAC, you can create the roles and assign them specific privileges or authorizations. You can then assign these roles to the appropriate users. This saves resources because you do not have to assign privileges to individual users. In this practice, you will work with a role `sdown` and `Shut` profile with authorization to execute the `shutdown` command. The following areas are covered in this practice:

- Managing roles and profiles
- Configuring a rights profile
- Working with individual authorizations
- Creating a systemwide RBAC policy

Task 1: Managing Roles and Profiles

This task covers the following activities:

- Creating a role
- Creating or changing a rights profile
- Assigning a rights profile to a role
- Assigning a role to a user
- Assuming a role
- Restricting an administrator to explicitly assigned rights

1. Verify that the S11-Desktop VM is running.
2. Use the `roleadd` command to add a role called `sdown` for shutdown. Using the `passwd` command, create a password for the `sdown` role.

```
root@s11-desktop:~# roleadd -u 3000 -g 10 -m -d \
/export/home/sdown sdown
80 blocks
root@s11-desktop:~# passwd sdown
New Password: oracle1
Re-enter new Password: oracle1
passwd: password successfully changed for sdown
```

A new role is added and the password created. Use the password `oracle1` so it can be remembered easily.

3. Verify the entries created in various files.

```
root@s11-desktop:~# getent passwd | grep sdown
sdown:x:3000:10::/export/home/sdown:/usr/bin/pfbash
root@s11-desktop:~# getent user_attr | grep sdown
sdown:::type=role;profiles=All;roleauth=role
```

As you can see, an entry in the `passwd` database was created very much like an entry for a new user. Notice the default shell.

An entry was also made in the `user_attr` database for `sdown`, which is marked as a role.

4. Use the `profiles` command to create a `Shut` profile that, when assigned to a user, can shut down a system.

```
root@s11-desktop:~# profiles -p Shut
profiles:Shut> set desc="Able to shutdown the system"
profiles:Shut> add cmd=/usr/sbin/shutdown
profiles:Shut:shutdown> set uid=0
profiles:Shut:shutdown> end
profiles:Shut> commit
profiles:Shut> exit
root@s11-desktop:~# getent prof_attr | grep Shut
Shut:::Able to shutdown the system:
…
…
root@s11-desktop:~# getent exec_attr | grep Shut
Shut:solaris:cmd:::/usr/sbin/shutdown:uid=0
…
```

Here you created a new rights profile called `Shut`.

5. Use the `rolemod` command to assign the profile `Shut` to the `sdown` role.

```
root@s11-desktop:~# rolemod -P Shut sdown
root@s11-desktop:~# getent user_attr | grep sdown
sdown:::profiles=Shut;type=role;roleauth=role
root@s11-desktop:~#
```

Note the profiles entry in the `user_attr` database.

6. Create a user called `abell` and assign her the `sdown` role. Create a password. Confirm that an entry is made in the `/etc/user_attr` file.

```
root@s11-desktop:~# useradd -u 60020 -g 10 -m –d \
/export/home/abell -s /bin/bash -R sdown -c "anna bell" abell
80 blocks
root@s11-desktop:~# passwd abell
New Password: oracle1
```

```
Re-enter new Password: oracle1
passwd: password successfully changed for abell
root@s11-desktop:~# getent user_attr | grep abell
abell:::: roles=sdown
```

Note the entry in the `user_attr` database for Anna Bell with the `sdown` role. Why? *Because you assigned her the role `sdown`.*

7. Now, log in to the `abell` account and use the `shutdown` command to reboot the system.

```
root@s11-desktop:~# su - abell
Oracle Corporation    SunOS 5.11     11.3       September 2015
abell@s11-desktop:~$ /usr/sbin/shutdown -i 6 -g 0
/usr/sbin/shutdown:  Only root can run /usr/sbin/shutdown
```

As expected, Anna Bell does not have the privileges to shut down the system.

8. Execute the `profiles` and `roles` commands to determine Anna's privileges.

```
abell@s11-desktop:~$ profiles
Basic Solaris User
All
abell@s11-desktop:~$ roles
sdown
```

Anna has been assigned the `sdown` role. When? *When you created her account*

9. Log in with the `sdown` role and use the `init` command to shut down the system.

```
abell@s11-desktop:~$ su sdown
Password: oracle1
sdown@s11-desktop:~$ id
uid=3000(sdown) gid=10(staff)
sdown@s11-desktop:~$ /usr/sbin/init 6
init: unable to open /dev/fb to load the shutdown image:
Permission denied
bootadm: you must be root to run this command
Must be super-user
```

Why can't Anna reboot the system? *She is not allowed the privilege of using the `init` command.*

10. Using the `profiles –l` command, obtain the privileged commands that Anna can use.

```
sdown@s11-desktop:~$ profiles -l
Shut
       /usr/sbin/shutdown         uid=0
Basic Solaris User
```

```
    auths=solaris.mail.mailq,solaris.network.autoconf.read,sola
ris.admin.wusb.read
    profiles=All
       /usr/bin/cdrecord.bin
privs=file_dac_read,sys_devices,proc_lock_memory,proc_priocntl,n
et_privaddr
       /usr/bin/readcd.bin
privs=file_dac_read,sys_devices,net_privaddr
       /usr/bin/cdda2wav.bin
privs=file_dac_read,sys_devices,proc_priocntl,net_privaddr
All
       *
sdown@s11-desktop:~$
```

Does the `sdown` role have the privilege to execute the `init` command? *No*.

Can this role execute the `shutdown` command? *Yes, as part of the `Shut` profile.*

11. Now use the `shutdown` command to attempt to bring down the system. To save time, respond with `n` when prompted to continue shutting down.

```
sdown@s11-desktop:~$ /usr/sbin/shutdown -i 6 -g 0

Shutdown started.    Monday, September 28, 2015 10:43:38 AM MDT

Do you want to continue? (y or n):  n
Broadcast Message from root (pts/2) on s11-desktop Mon Sep 28
10:44:03...
False Alarm:  The system s11-desktop will not be brought down.
Shutdown aborted.
sdown@s11-desktop:~$
```

Were you able to execute the `shutdown` command? *Yes.*

12. Use the `profiles` command to display the profiles assigned to the `sdown` role.

```
sdown@s11-desktop:~$ profiles
Shut
Basic Solaris User
All
```

The `sdown` profile has three profiles assigned: `Shut`, `Basic Solaris User`, and `All`.

13. Log out of the `sdown` role and Anna's account.

```
sdown@s11-desktop:~$ exit
exit
abell@s11-desktop:~$ exit
logout
```

14. Now you want to delete the `Shut` profile from the profiles assigned to the `sdown` role. Use the `rolemod` command to delete the profile.

```
root@s11-desktop:~# rolemod -P "Basic Solaris User,All,Stop" \
sdown
root@s11-desktop:~#
```

Referring to the output in Step 8, by using the Stop profile, you are taking away the `Shut` profile from `sdown`. This command is especially useful if you have many (for example, 15) profiles assigned to a role and you want to limit the role to only a few profiles.

15. Log in to Anna Bell's account, assume the `sdown` role, and attempt to use the `shutdown` command as before.

```
root@s11-desktop:~# su - abell
Oracle Corporation    SunOS 5.11     11.3       September 2015
abell@s11-desktop:~$ su sdown
Password: oracle1
sdown@s11-desktop:~$ /usr/sbin/shutdown -i 6 -g 0
/usr/sbin/shutdown:  Only root can run /usr/sbin/shutdown
sdown@s11-desktop:~$ exit
exit
```

You are back to where Anna Bell cannot issue the `shutdown` command by using the `sdown` role. If you display the current profiles assigned to `sdown`, you see only the remaining profiles.

```
abell@s11-desktop:~$ profiles
Basic Solaris User
All
```

Exit Anna Bell's user account.

```
abell@s11-desktop:~$ exit
logout
root@s11-desktop:~#
```

Task 2: Assigning Profiles Directly to a User

1. Verify that the S11-desktop VM is running.
2. Use the `usermod` command to assign the `"User Management"` profile to an existing user `jholt`. Verify the entry in the `/etc/user_attr` file.

```
root@s11-desktop:~# usermod -P "User Management" jholt
root@s11-desktop:~# getent user_attr | grep jholt
jholt::::profiles=User Management; defaultpriv=basic

Yes, it is there.
```

3. Log in to the `jholt` account. Use the `profiles` command to display the current profiles assigned.

```
root@s11-desktop:~# su - jholt
Oracle Corporation    SunOS 5.11     11.3       September 2015
jholt@s11-desktop:~$ profiles -l
User Management
    auths=solaris.user.manage,solaris.role.manage,solaris.group
.manage,solaris.project.delegate
          /usr/bin/logins            privs=all
          /usr/sbin/grpck            euid=0
          /usr/sbin/pwck             euid=0
          /usr/sbin/useradd          euid=0
          /usr/sbin/userdel          euid=0
          /usr/sbin/usermod          euid=0
          /usr/sbin/roleadd          euid=0
          /usr/sbin/roledel          euid=0
          /usr/sbin/rolemod          euid=0
          /usr/sbin/groupadd         euid=0
          /usr/sbin/groupdel         euid=0
          /usr/sbin/groupmod         euid=0
Basic Solaris User
    auths=solaris.mail.mailq,solaris.network.autoconf.read,sola
ris.admin.wusb.read
    profiles=All
          /usr/bin/cdrecord.bin
privs=file_dac_read,sys_devices,proc_lock_memory,proc_priocntl,n
et_privaddr
          /usr/bin/readcd.bin
privs=file_dac_read,sys_devices,net_privaddr
          /usr/bin/cdda2wav.bin
privs=file_dac_read,sys_devices,proc_priocntl,net_privaddr
All
          *
```

Observe that the user `jholt` now has authorizations to add, modify, and delete users, roles, and groups.

4. Using the `useradd` command, attempt to create a new user as `adam walker`.

```
jholt@s11-desktop:~$ pfbash
jholt@s11-desktop:~$ useradd -u 60010 -g 10 -d
/export/home/awalker -m -s /bin/bash -c "adam walker" awalker
80 blocks
jholt@s11-desktop:~$ getent passwd | grep awalker
awalker:x:60010:10:adam walker:/export/home/awalker:/bin/bash
jholt@s11-desktop:~$ passwd awalker
Permission denied
```

Can `jholt` create a new user? *Yes.*

Can `jholt` set the password to `awalker`? *No. In step 3, you can observe that User Management does not provide authorizations to use the `/usr/bin/passwd` command.*

5. Log out of John Holt's account to return to the superuser account. Take away the profile from `jholt` and confirm that he doesn't have the authorization to manage users anymore.

```
jholt@s11-desktop:~$ exit
logout
jholt@s11-desktop:~$ exit
logout
root@s11-desktop:~# usermod –P “” jholt
root@s11-desktop:~# getent user_attr | grep jholt
jholt:::: defaultpriv=basic
```

Task 3: Assigning Authorization Directly to a User

1. Verify that the S11-desktop VM is running.
2. Temporarily log in to the `jmoose` account. Use the `crontab` command to determine if you have the authorization to display the `crontab` contents for the superuser.

```
root@s11-desktop:~# su - jmoose
Oracle Corporation    SunOS 5.11     11.3       September 2015
jmoose@s11-desktop:~$ crontab -l root
crontab: you must be super-user to access another user's crontab
file
jmoose@s11-desktop:~$ exit
logout
root@s11-desktop:~#
```

As expected, the `jmoose` account does not have the authorization to list the `root`'s `crontab` file.

3. Using the `usermod` command, assign Jerry Moose the authorization for job administration.

```
root@s11-desktop:~# usermod -A solaris.jobs.admin jmoose
root@s11-desktop:~# getent user_attr | grep jmoose
jmoose:::auths=solaris.jobs.admin
root@s11-desktop:~# auths jmoose | grep jobs
solaris.admin.wusb.read,solaris.jobs.admin,solaris.mail.mailq,so
laris.network.autoconf.read
root@s11-desktop:~#
```

Does Jerry Moose have the right authorizations now? *Yes.*

4. Log in as `jmoose` and issue the `crontab` command now.

```
root@s11-desktop:~# su - jmoose
Oracle Corporation    SunOS 5.11     11.3      September 2015
jmoose@s11-desktop:~$ crontab -l root
#ident    "%Z%%M%    %I%   %E% SMI"
#
# Copyright 2007 Sun Microsystems, Inc.  All rights reserved.
# Use is subject to license terms.
#
#
# The root crontab should be used to perform accounting data
collection.
#
#
10 3 * * * /usr/sbin/logadm
15 3 * * 0 [ -x /usr/lib/fs/nfs/nfsfind ] &&
/usr/lib/fs/nfs/nfsfind
30 3 * * * [ -x /usr/lib/gss/gsscred_clean ] &&
/usr/lib/gss/gsscred_clean
30 0,9,12,18,21 * * * /usr/lib/update-manager/update-refresh.sh
jmoose@s11-desktop:~$
```

Can Jerry Moose access the `crontab` file for the `root` account now? *Yes*.

5. Log out of Jerry Moose's account to return to the superuser account. Take away the authorization from Jerry Moose. Confirm that he does not have the authorization anymore.

```
jmoose@s11-desktop:~$ exit
logout
root@s11-desktop:~# usermod -A "" jmoose
root@s11-desktop:~# getent user_attr | grep jmoose
root@s11-desktop:~# su - jmoose
Oracle Corporation    SunOS 5.11     11.3      September 2015
jmoose@s11-desktop:~$ crontab -l root
crontab: you must be super-user to access another user's crontab
file
```

```
jmoose@s11-desktop:~$ exit
logout
```

Jerry Moose cannot access the superuser's `crontab` file.

This task demonstrates the direct assignment of an authorization and usage of that authorization.

Task 4: Creating a System-wide RBAC Policy

1. Verify that the S11-desktop VM is running.
2. Temporarily log in to the `jmoose` account. Use the `ppriv` command to display the privilege sets.

```
root@s11-desktop:~# su - jmoose
Oracle Corporation    SunOS 5.11     11.3      September 2015
jmoose@s11-desktop:~$ ppriv $$
12687: -bash
flags = <none>
     E: basic
     I: basic
     P: basic
     L: all
```

3. Use the `ps` command to display all the processes.

```
jmoose@s11-desktop:~$ ps -A -o user -o pid -o comm | more
  USER   PID COMMAND
    root     0 sched
    root     5 zpool-rpool
    root     6 kmem_task
    root     1 /usr/sbin/init
    root     2 pageout
    root     3 fsflush
    root     7 intrd
    root     8 vmtasks
    root     9 postwaittq
  daemon    73 /lib/crypto/kcfd
    root    13 /lib/svc/bin/svc.startd
    root    12 /lib/svc/bin/svc.configd
   dladm    47 /usr/sbin/dlmgmtd
    root    96 /usr/lib/pfexecd
  ...
  ...
```

Can you display the processes for any user? *Yes.*

4. Exit the `jmoose` account and, as the administrator, modify the `/etc/security/policy.conf` file as indicated below in the `cat` command output.

```
jmoose@s11-desktop:~$ exit
logout
root@s11-desktop:~# pfedit /etc/security/policy.conf
root@s11-desktop:~# cat /etc/security/policy.conf | grep \
PRIV_DEFAULT
# There are two different settings; PRIV_DEFAULT determines the
default
# Similarly, PRIV_DEFAULT=basic,!file_link_any takes away only
the
#PRIV_DEFAULT=basic
PRIV_DEFAULT=basic,!proc_info,!proc_session
```

This file establishes a systemwide policy. You are denying a nonadministrative user the privilege to look at the processes of other users.

Now reboot the system for the policy to take effect.

```
root@s11-desktop:~# init 6
```

Note: The reboot may take a few minutes to complete.

5. Log in and assume administrator privileges. Open a terminal window.
6. Log in to the `jmoose` account and issue the same `ps` command to access the processes.

```
root@s11-desktop:~# su - jmoose
Oracle Corporation    SunOS 5.11     11.3       September 2015
jmoose@s11-desktop:~$ ps -A -o user -o pid -o comm | more
    USER   PID  COMMAND
  jmoose  3691  ps
  jmoose  3687  -bash
jmoose@s11-desktop:~$
```

Now you are able to display only your own processes. Would that be true for any user? *Yes.*

7. Exit the `jmoose` account, and then issue the `ps` command.

```
jmoose@s11-desktop:~$ exit
logout
root@s11-desktop:~# ps -ef | more
     UID   PID  PPID   C    STIME TTY         TIME CMD
    root     0     0   0 10:10:27 ?           0:04 sched
    root     5     0   0 10:10:26 ?           0:02 zpool-rpool
    root     6     0   0 10:10:28 ?           0:00 kmem_task
    root     1     0   0 10:10:28 ?           0:00
/usr/sbin/init
    root     2     0   0 10:10:28 ?           0:00 pageout
    root     3     0   0 10:10:28 ?           0:00 fsflush
    root     7     0   0 10:10:28 ?           0:00 intrd
    root     8     0   0 10:10:28 ?           0:00 vmtasks
    root     9     0   0 10:10:28 ?           0:00 postwaittq
    root    15     1   0 10:10:28 ?           0:35
/lib/svc/bin/svc.configd
    root    13     1   0 10:10:28 ?           0:12
/lib/svc/bin/svc.startd
  oracle  1389  1378   0 10:12:56 ?           0:01 gnome-session
  oracle  1451  1389   0 10:13:33 ?           0:00 metacity
  netadm    73     1   0 10:10:44 ?           0:00
/lib/inet/ipmgmtd
    root   261     1   0 10:11:00 ?           0:00
/usr/lib/pfexecd
    root   997    13   0 10:11:52 vt/6        0:00
/usr/sbin/ttymon -g -d /dev/v
t/6 -l console -m ldterm,ttcompat -h -p s11-deskto
  netcfg    47     1   0 10:10:38 ?           0:00
/lib/inet/netcfgd
    root   733     1   0 10:11:41 ?           0:05
/usr/sbin/nscd
    root    91     1   0 10:10:49 ?           0:00
/lib/inet/in.mpathd
    root   114     1   0 10:10:51 ?           0:00
/usr/lib/rad/rad -sp
…
…
…
```

The administrator account can still access all the processes.

Note: The output may vary from system to system.

8. Reset the process parameters in `/etc/security/policy.conf` to the original value. Display all the processes as Jerry Moose.

```
root@s11-desktop:~# pfedit /etc/security/policy.conf
root@s11-desktop:~# cat /etc/security/policy.conf | grep \
PRIV_DEFAULT
# There are two different settings; PRIV_DEFAULT determines the
default
# Similarly, PRIV_DEFAULT=basic,!file_link_any takes away only
the
#PRIV_DEFAULT=basic
root@s11-desktop:~#
```

Now reboot the system for the policy to take effect.

```
root@s11-desktop:~# init 6
```

Note: The reboot may take a few minutes to complete.

Log in and assume administrator privileges. Then log in to the `jmoose` account.

```
root@s11-desktop:~# su - jmoose
Oracle Corporation    SunOS 5.11     11.3       September 2015
jmoose@s11-desktop:~$ ps -ef | more
     UID   PID  PPID   C    STIME TTY         TIME CMD
    root     0     0   0 10:22:36 ?           0:04 sched
    root     5     0   0 10:22:35 ?           0:01 zpool-rpool
    root     6     0   0 10:22:37 ?           0:00 kmem_task
    root     1     0   0 10:22:37 ?           0:00
/usr/sbin/init
    root     2     0   0 10:22:37 ?           0:00 pageout
    root     3     0   0 10:22:37 ?           0:00 fsflush
    root     7     0   0 10:22:37 ?           0:00 intrd
    root     8     0   0 10:22:37 ?           0:00 vmtasks
    root     9     0   0 10:22:37 ?           0:00 postwaittq
    root   263     1   0 10:23:14 ?           0:00
/usr/lib/pfexecd
    root    13     1   0 10:22:39 ?           0:12
/lib/svc/bin/svc.startd
    root    15     1   0 10:22:39 ?           0:35
/lib/svc/bin/svc.configd
    root    90     1   0 10:23:00 ?           0:00
/lib/inet/in.mpathd
  netcfg    46     1   0 10:22:52 ?           0:00
/lib/inet/netcfgd
```

```
   root   807   775   0 10:23:57 ?           0:00
/usr/lib/hal/hald-addon-cpufr
eq
  netadm    74     1   0 10:22:58 ?           0:00
/lib/inet/ipmgmtd
  daemon   678     1   0 10:23:51 ?           0:00
/usr/sbin/rpcbind
   root   350     1   0 10:23:19 ?           0:00
/sbin/dhcpagent
  oracle  1461  1385   0 10:24:46 ?           0:00 python2.6
/usr/lib/system-con
…
…
…
```

Now Jerry Moose can display the processes for any user.

This completes the systemwide policy configuration for RBAC.

Exit the `jmoose` account.

```
jmoose@s11-desktop:~$ exit
logout
```

Practice 8-3: Monitoring and Restricting the Superuser (`su` log)

Overview

As part of the predeployment testing plan, you are tasked with monitoring and restricting the superuser. As a system administrator, it is your responsibility to control and monitor system activity. You can control system activity by setting limits on who can use what resources. You can also log resource use, and you can monitor who is using the resources. As you are already aware, there are two common ways to access a system: by using a conventional user login or by using the root login. You also know how the `su` command can be used to enable a user to run administrative commands without using the root account.

Tasks

1. Verify that the S11-Desktop VM is running.
2. From your administrator login, switch user to `jholt` by using the `su` command. Then switch user to the `jmoose` account and enter an incorrect password.

```
root@s11-desktop:~# id
uid=0(root) gid=0(root)
root@s11-desktop:~# su – jholt
Oracle Corporation      SunOS 5.11      11.3    September 2015
jholt@s11-desktop:~$ su - jmoose
Password:
su: Sorry
jholt@s11-desktop:~$ exit
logout
root@s11-desktop:~#
```

Are you back to the administrator login? *Yes, the command prompt # informs you so.*

3. Use the `tail` command to examine the most recent entries in the `/etc/default/su` file.

```
root@s11-desktop:~# tail /var/adm/sulog
SU 02/27 10:15 + pts/1 oracle-jmoose
SU 02/27 10:17 - ??? oracle-root
SU 02/27 10:17 + ??? oracle-root
SU 02/27 10:21 + ??? root-oracle
SU 02/27 10:25 + pts/1 oracle-root
SU 02/27 10:25 + pts/1 oracle-jmoose
SU 02/27 10:26 - ??? oracle-root
SU 02/27 10:26 + ??? oracle-root
SU 02/27 10:36 + pts/1 oracle-jholt
SU 02/27 10:37 - pts/1 oracle-jmoose
```

Can you match the entries for the `su` command used in step 2? *Yes, the last two entries.*

> Note that instead of `root`, it shows switching from `oracle` to `jholt`, because you are logged in as the `oracle` account, which has administration rights. In addition, note the plus (+) sign for successful login and the minus (-) sign for a failed login attempt. Refer to step 4.

4. From the desktop menu, log out of S11-Desktop, shut it down, and then start it again. Log in as `jmoose` with `oracle1` as the password. Select `gnome` and select `English (US)` for keyboard layout and for language, select `English (United States)` if prompted for Preferences. Right-click the desktop and open a terminal window. Use the `su -` command to switch between users to create some entries in the `sulog`.

```
oracle@s11-desktop:~$ su - jmoose
jmoose@s11-desktop:~$ su -
Password: oracle1
Roles can only be assumed by authorized users.
su: Sorry
jmoose@s11-desktop:~$ su - jholt
Password: [enter incorrect password]
su: Sorry
```

Switch to the administrator account through the `oracle` account.

```
jmoose@s11-desktop:~$ su - oracle
Password: oracle1
Oracle Corporation      SunOS 5.11      11.3    September 2015
oracle@s11-desktop:~$ su -
Password: oracle1
Oracle Corporation      SunOS 5.11      11.3    September 2015
root@s11-desktop:~#
```

5. Examine the entries in `sulog`.

```
root@s11-desktop:~# tail /var/adm/sulog
SU 09/27 10:25 + pts/1 oracle-root
SU 09/27 10:25 + pts/1 oracle-jmoose
SU 09/27 10:26 - ??? oracle-root
SU 09/27 10:26 + ??? oracle-root
SU 09/27 10:36 + pts/1 oracle-jholt
SU 09/27 10:37 - pts/1 oracle-jmoose
SU 09/27 10:44 - pts/1 jmoose-root
SU 09/27 10:44 - pts/1 jmoose-jholt
SU 09/27 10:45 + pts/1 jmoose-oracle
SU 09/27 10:45 + pts/1 jmoose-root
```

Now you can see more clearly. Can you match the entries since your fresh login as `jmoose`? *Yes, the last four entries match the commands in the previous step.*

But why does it tell you that you are switching from `jmoose` every time? Examine the following commands for the answer.

```
root@s11-desktop:~# whoami
root
root@s11-desktop:~# who am i
jmoose   pts/2        Sep 25 10:44 (:0.0)
```

The first command, `whoami`, shows your effective `userid` (switched to) and the next command tells you the original `userid` that you used to log in to the system. Now you should understand how the system records the `su` entries.

6. Restart the S11-Desktop VM. Log in as the `oracle` user. Use `oracle1` as the password.

Practice 8-4: Verifying File Integrity by Using BART

Overview

In this practice, you create a BART rules file and apply it to a BART report. You then compare BART reports to determine whether changes occurred in the `/export/home/oracle1` directory.

Task

Perform the following steps with the `root` role and verify file integrity by using BART:

1. Change directory to `/var/tmp` and create a BART rules file named `bartrules` that contains these rules:

   ```
   IGNORE all
   /export/home/oracle
   CHECK all
   ```

   ```
   root@s11-desktop:~# cd /var/tmp
   root@s11-server1:/var/tmp# vi bartrules
   IGNORE all
   /export/home/oracle
   CHECK all
   ```

2. Create a BART report by using the rules file that you created in the previous step and display the results.

   ```
   root@s11-desktop:/var/tmp# bart create -r bartrules >  \
   bart-`hostname`-`date '+%d%m%y-%H:%M:%S'`

   root@s11-desktop:/var/tmp# ls bart*
   bart-s11-desktop-280915-04:44:00  bartrules
   ```

3. View the contents of the BART report.

   ```
   root@s11-desktop:/var/tmp# more bart-s11-desktop-280915-04:44:00
   ! Version 1.1
   ! Hash SHA256
   ! Monday, September 28, 2015 (04:44:00)
   # Format:
   #fname D size mode acl dirmtime uid gid
   #fname P size mode acl mtime uid gid
   #fname S size mode acl mtime uid gid
   #fname F size mode acl mtime uid gid contents
   #fname L size mode acl lnmtime uid gid dest
   #fname B size mode acl mtime uid gid devnode
   #fname C size mode acl mtime uid gid devnode
   /export/home/oracle D 40 40755
   owner@:list_directory/read_data/add_file/write_data/add_subdirector
   y/append_data/read_xattr/write_xattr/execute/delete_child/read_attributes/writ
   e_attributes/read_ac
   l/write_acl/write_owner/synchronize:allow,group@:list_directory/read_data/read
   _xattr/execute/read_
   attributes/read_acl/synchronize:allow,everyone@:list_directory/read_data/read_
   xattr/execute/read_a
   ttributes/read_acl/synchronize:allow 5608c28b 100 10
   ```

```
/export/home/oracle/.ICEauthority F 1507 100600
owner@:read_data/write_data/append_data/read_xattr
/write_xattr/read_attributes/write_attributes/read_acl/write_acl/write_owner/s
ynchronize:allow,gro
up@:read_xattr/read_attributes/read_acl/synchronize:allow,everyone@:read_xattr
/read_attributes/rea
d_acl/synchronize:allow 560519f4 100 10
d42ab8def1b683a84a3cbb89abfdd6776845df80f5e3ef44259965d901
94bbcc
/export/home/oracle/.audioctl D 3 40700
owner@:list_directory/read_data/add_file/write_data/add_su
bdirectory/append_data/read_xattr/write_xattr/execute/delete_child/read_attrib
utes/write_attribute
s/read_acl/write_acl/write_owner/synchronize:allow,group@:read_xattr/read_attr
ibutes/read_acl/sync
hronize:allow,everyone@:read_xattr/read_attributes/read_acl/synchronize:allow
55ed4d54 100 10
/export/home/oracle/.audioctl/audioctl-s11-desktop-audio810#0 F 711 100600
owner@:read_data/write_
--More--(1%)
(output truncated)
```

4. Create a file named `newfile` in the `/export/home/oracle` directory.

```
root@s11-desktop:/var/tmp# touch /export/home/oracle/newfile
```

5. Create another BART report by using the rules file and display the results.

```
root@ s11-desktop:/var/tmp# bart create -r bartrules >     \
bart-`hostname`-`date '+%d%m%Y-%H:%M:%S'`

root@s11-desktop:/var/tmp# ls bart*
bart-s11-desktop-280915-04:44:00  bartrules
bart-s11-desktop-280915-04:47:36
```

6. Compare the two BART reports.

```
root@s11-desktop:/var/tmp# bart compare -r bartrules  \
bart-s11-desktop-280915-04:44:00  \
bart-s11-desktop-280915-04:47:36  \
/export/home/oracle:
  size  control:40  test:41
  dirmtime  control:5608c28b  test:5608c635
/export/home/oracle/newfile:
  add
```

7. Edit the `/export/home/oracle/newfile` file by adding a simple message.

```
root@s11-desktop:/var/tmp# vi /export/home/oracle/newfile
This is a test.
```

8. Create another BART report by using the rules file and display the results.

```
root@s11-desktop:/var/tmp# bart create -r bartrules >      \
bart-`hostname`-`date '+%d%m%Y-%H:%M:%S'`

root@s11-desktop:/var/tmp# ls bart*
bart-s11-desktop-280915-04:44:00  bart-s11-desktop-280915-04:51:09
```

```
bart-s11-desktop-280915-04:47:36  bartrules
root@s11-desktop:/var/tmp#
```

9. Compare the second and third BART reports.

```
root@s11-desktop:/var/tmp# bart compare -r bartrules  \
bart-s11-desktop-280915-04:47:36  \
bart-s11-desktop-280915-04:51:09  \
/export/home/oracle:
  dirmtime  control:5608c635  test:5608c71b
/export/home/oracle/newfile:
  size  control:0  test:16
  mtime  control:5608c635  test:5608c71b
  contents
control:e3b0c44298fc1c149afbf4c8996fb92427ae41e4649b934ca495991b7852b8
55
test:11586d2eb43b73e539caa3d158c883336c0e2c904b309c0c5ffe2c9b83d562a1
root@s11-desktop:/var/tmp#
```

10. Close the terminal window.

Practice 8-5: Assessing the Compliance of an Oracle Solaris System

Overview

The Oracle Solaris 11 OS provides the `compliance` command to assess system compliance and generate reports against the following security benchmarks:

- Solaris security policy benchmark
- Payment Card Industry Data Security Standard (PCI DSS) Security policy benchmark

In addition, Oracle Solaris 11 also supports creating tailorings from the existing security benchmarks.

In this practice, you will perform the following tasks:

- Assess the security compliance of an Oracle Solaris System
- Create tailorings from existing security benchmarks

Task 1: Assess the Security Compliance of an Oracle Solaris System

To assess the compliance of an Oracle Solaris system against the PCI DSS security policy benchmark, perform the following steps on the S11-Desktop VM:

1. Assume the administrative privileges. Ensure that the compliance package is installed in every zone where you plan to run compliance tests.

```
root@s11-desktop:~# pkg install compliance
           Packages to install:  9
            Services to change:  2
       Create boot environment: No
Create backup boot environment: No

DOWNLOAD                            PKGS         FILES    XFER (MB)   SPEED
Completed                            9/9     1734/1734      9.2/9.2  158k/s

PHASE                                          ITEMS
Installing new actions                     1915/1915
Updating package state database                 Done
Updating package cache                           0/0
Updating image state                            Done
Creating fast lookup database                   Done
Updating package cache                           1/1
root@s11-desktop:~# pkg install compliance
No updates necessary for this image.
```

2. List the benchmarks and profiles that are available.

```
root@s11-desktop:~# compliance list -p
Benchmarks:
pci-dss:        Solaris_PCI-DSS
solaris:        Baseline, Recommended
Assessments:
      No assessments available
```

3. Create an assessment by using the `Solaris_PCI-DSS` profile and the `pci-dss` benchmark and save the assessments in a user-defined compliance repository directory.

```
root@s11-desktop:~# compliance assess -p Solaris_PCI-DSS -b pci-dss -a pci-dss
Title   The OS version is current
Rule    OSC-53005
Result  pass

Title   Package integrity is verified
Rule    OSC-54005
Result  fail

Title   Package signature checking is globally activated
Rule    OSC-53505
Result  pass

Title   Booting the system should require a password
Rule    OSC-04511
Result  fail
...
```

Note: This step might take up to 15 to 30 minutes.

In the preceding command, the `-a pci-dss` option creates a compliance repository directory by the name `pci-dss` in the `/var/share/compliance` directory to store the assessment information.

4. List the assessments available in the `pci-dss` compliance repository.

```
root@s11-desktop:~# compliance list -v -a pci-dss
pci-dss:    log report.html results.xccdf.xml
```

The preceding output lists the following components of the `pci-dss` compliance repository:

- `log`: A plain text log file
- `report.html`: An HTML file
- `results.xccdf.xml`: An XML file

5. Locate the assessments in the `pci-dss` compliance repository.

```
root@s11-desktop:~# compliance report -a pci-dss
/var/share/compliance/assessments/pci-dss/report.html

root@s11-desktop:~# compliance report -f log -a pci-dss
/var/share/compliance/assessments/pci-dss/log

root@s11-desktop:~# compliance report -f xccdf -a pci-dss
/var/share/compliance/assessments/pci-dss/results.xccdf.xml
```

6. View the assessments.

You can view the log file in a text editor, the HTML file in a browser, and the XML file in an XML viewer.

7. Fix any failures that your security policy requires to pass.

   Note: For the purpose of this practice, you need not fix the failures. However, it is recommended that you go through the assessment reports and get yourself familiar with the compliance policy and the recommended fixes.

Task 2: Create Tailorings from an Existing Security Benchmark

To create tailorings from an existing security policy benchmark, perform the following steps on the S11-Desktop VM:

1. Open the compliance editor to create a tailoring.

```
root@s11-desktop:~# compliance tailor -t baselinecustom
*** compliance tailor: No existing tailoring 'baselinecustom', initializing
tailoring:baselinecustom> info
Properties:
        tailoring=baselinecustom
        benchmark: not set
        profile: not set
```

2. Set the benchmark as `solaris`, profile as `Baseline`, and exclude all rules.

```
tailoring:baselinecustom> set benchmark=solaris
tailoring:baselinecustom> set profile=Baseline
tailoring:baselinecustom> info
Properties:
        tailoring=baselinecustom
        benchmark=solaris
        profile=Baseline
tailoring:baselinecustom> exclude -a
Discard existing rule selections (y/N)? y
```

3. Open the `pick` screen to navigate and include particular rules.

```
tailoring:baselinecustom> pick
…
> _   OSC-53005  The OS version is current
> _   OSC-16005  All local filesystems are ZFS
> _   OSC-61510  root login by using ssh(1) is disabled
> _   OSC-46014  Passwords require at least 14 characters
> _   OSC-59000  root is a role
> _   OSC-04511  Booting the system should require a password
…
```

   Press `Esc` or `q` key to exit the `pick` screen.

4. Commit the changes and exit the compliance editor.

```
tailoring:baselinecustom> commit
tailoring:baselinecustom> exit
root@s11-desktop:~#
```

5. List the tailoring.

```
root@s11-desktop:~# compliance tailor list
        baselinecustom
```

6. Test the tailoring on a system and evaluate the output.

```
root@s11-desktop:~# compliance assess -t baselinecustom
Assessment will be named 'baselinecustom.2015-09-11,12:04'
```

7. Locate the assessment.

```
root@s11-desktop:~# compliance report
/var/share/compliance/assessments/baselinecustom.2015-09-11,12:04/report.html
```

8. Display the assessment in a web browser.

Practices for Lesson 9: Managing Processes and Priorities

Chapter 9

Practices for Lesson 9: Overview

Practices Overview

In these practices, you are presented with a plan for managing the Oracle Solaris 11 processes, scheduling classes, and process priorities.

According to the predeployment test plan, you are going to evaluate various system processes. Assume you are supporting Oracle CRM and Financial applications. These applications will launch multiple processes and you will need to know which processes should run as high or low priority. Therefore, you are asked to assess the processes, their priorities, and scheduling classes. You are presented with various situations that will help you evaluate and configure the facilities. The key areas explored in the practices are:

- Modifying process scheduling priority
- Configuring the fair share scheduler (FSS) in an Oracle Solaris Zone

Note: Your display outputs will be different due to the type of tasks, processes, and users.

Check your progress. You just completed the “Securing the Oracle Solaris 11 OS” lesson and are now working with processes and priorities.

	Oracle Solaris 11 Predeployment Checklist
✓	Managing Services and Service Properties by Using SMF
✓	Managing Software Packages by Using IPS
✓	Managing Data Backup and Restore by Using ZFS
✓	Configuring the Network
✓	Administering Network Services
✓	Advanced Administration of Zones
✓	Securing the Oracle Solaris 11 OS
	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practice 9-1: Modifying Process Scheduling Priority

Overview

In this practice, you work with the processes in the following areas:

- Managing scheduling class and process priorities
- Configuring the fair share scheduler

Task 1: Managing Scheduling Class and Process Priorities

This task covers the following activities:

- Listing the current processes
- Displaying process class information
- Determining the process global priority
- Designating a process priority
- Modifying process scheduling priority
- Changing the scheduling parameters of a timesharing process

1. Verify that the S11-Desktop VM is running.

   If it is not, start it now. Log in as the `oracle` user. Use the password `oracle1`. Assume administrator privileges.

2. Use the `top` command to view the top 10 processes at a 10-second interval.

```
root@s11-desktop:~# top 10 -s 10
last pid: 17291;  load avg:  0.06,  0.06, 0.05; up 2+21:45:28 07:37:17
120 processes: 119 sleeping, 1 on cpu
CPU states: 97.7% idle,  0.4% user,  1.9% kernel,  0.0% iowait,  0.0% swap
Kernel: 501 ctxsw, 714 intr, 641 syscall
Memory: 3100M phys mem, 229M free mem, 1024M total swap, 1024M free swap

   PID USERNAME NLWP PRI NICE  SIZE   RES STATE    TIME    CPU COMMAND
  1034 oracle     21  59    0  173M   71M sleep   22:23  0.27% java
   816 oracle      3  59    0   73M   37M sleep    1:09  0.15% Xorg
  1060 oracle      3  59    0   13M  360K sleep    9:21  0.11% VBoxClient
  1081 oracle      2  55    0  130M 9876K sleep    0:43  0.10% gnome-terminal
  4670 oracle      1  49    0  147M   28M sleep    0:07  0.09% gedit
   506 root       10  59    0  143M   72M sleep    5:41  0.07% poold
 17290 root        1  59    0 4608K 2964K cpu/1    0:00  0.05% top
   487 root        7  59    0   11M  816K sleep    1:03  0.01% VBoxService
  1026 oracle      1  12   19   67M 8428K sleep    0:40  0.01% updatemanagerno
  1028 oracle      1  59    0  137M 4188K sleep    0:38  0.01% isapython2.7
```

   Enter ‘`q`’ to exit.

   In what order is the `CPU` column sorted? *Descending, so that the processes using high CPU are displayed at the top*

   Note: Your display output will differ from the output presented here.

3. Use the `priocntl` command to view the configured classes.

```
root@s11-desktop:~# priocntl -l
```

```
CONFIGURED CLASSES
==================
SYS (System Class)

TS (Time Sharing)
    Configured TS User Priority Range: -60 through 60

SDC (System Duty-Cycle Class)

FSS (Fair Share)
     Configured FSS User Priority Range: -60 through 60

FX (Fixed priority)
    Configured FX User Priority Range: 0 through 60
IA (Interactive)
    Configured IA User Priority Range: -60 through 60
```

These are all the classes currently being used at this time.

4. Using the `ps` command, display the scheduling class and the priority of the processes currently running.

```
root@s11-desktop:~# ps -ecl | more
 F S    UID   PID  PPID  CLS PRI     ADDR     SZ    WCHAN TTY          TIME CMD
 1 T      0     0     0  SYS  96        ?      0            ?          0:04 sched
 1 S      0     5     0  SDC  99        ?      0          ? ?          0:03 zpool-rp
 1 S      0     6     0  SDC  99        ?      0          ? ?          0:02 kmem_tas
 0 S      0     1     0   TS  59        ?    767          ? ?          0:00 init
 1 S      0     2     0  SYS  98        ?      0          ? ?          0:00 pageout
 1 S      0     3     0  SYS  60        ?      0          ? ?          1:18 fsflush
 1 S      0     7     0  SYS  60        ?      0          ? ?          0:00 intrd
 1 S      0     8     0  SYS  60        ?      0          ? ?          0:00 vmtasks
 1 S      0     9     0  SDC  99        ?      0          ? ?          0:00 postwait
 0 S     17    43     1   TS  59        ?    920          ? ?          0:02 netcfgd
 0 S      0    13     1   TS  59        ?   5958          ? ?          0:13 svc.star
 0 S      0    15     1   TS  59        ?   5414          ? ?          0:57 svc.conf
 0 S     16    61     1   TS  59        ?   1102          ? ?          0:00 ipmgmtd
 0 S      0    84     1   TS  59        ?   2441          ? ?          0:01 in.mpath
 0 S      0   126     1   TS  59        ?    670          ? ?          0:00 pfexecd
 0 S     16   347     1   TS  59        ?   3180          ? ?          0:02 nwamd
 0 S     15    51     1   TS  59        ?   1093          ? ?          0:18 dlmgmtd
...
...
...
 0 S    100  1488  1389   IA  12        ?  16125          ? ?          0:16 updatema
 0 S    100  1494     1   IA  59        ?   3370          ? ?          0:00 VBoxClie
 0 S    100  1532   177   TS  59        ?   4326          ? ?          0:00 rad
 0 S    100  1539  1538   IA  59        ?    608          ? ?          0:00 gnome-pt
 0 S    100  1500     1   IA  59        ?   3382          ? ?          0:00 VBoxClie
 0 S    100  1502     1   IA  59        ?   3333          ? ?          0:00 VBoxClie
```

```
 0 S    100  1526     1   IA  59        ?   3164        ? ?           0:00 gvfsd-me
 0 S    100  1529     1   IA  59        ?   8883        ? ?           0:00 notifica
 0 R    100  1515  1389   IA  59        ?   3653          ?           0:03 xscreens
 0 R      0  1543  1542   IA  29        ?   2557          pts/1       0:00 bash
 0 S      0  1542  1541   IA  49        ?   2566        ? pts/1       0:00 su
 0 R    100  1538     1   IA  59        ?  32821          ?           0:03 gnome-te
 0 S    100  1541  1538   IA  59        ?   2548        ? pts/1       0:00 bash
 0 S    100  1999     1   IA  49        ?   9479        ? ?           0:01 gksu
 0 S      0  2003  2002   IA  49        ?  35784        ? ?           0:02 gedit
 0 O      0  2018  1543   IA  59        ?   2332          pts/1       0:00 ps
 0 S      0  2010     1   IA  49        ?   3522        ? ?           0:00 gconfd-2
 0 S      0  2007     1   IA  49        ?    849        ? ?           0:00 dbus-dae
 0 S      0  2008     1   IA  49        ?    952        ? ?           0:00 dbus-lau
```

What is the highest priority in use? *It is 99 for the `zpool` process.*

What is the lowest priority in use? *It is 12 for the `updatemanager` process.*

Refer to the man pages for detailed explanation of the columns.

Note: The values may differ from system to system.

5. Use the `priocntl` command to generate a process in the `TS` scheduling class with a specified priority of `60` by using the `find` command.

```
root@s11-desktop:~# priocntl -e -c TS -m 60 -p 60 find / -name
core -exec ls {} \; > /var/tmp/find 2<>/dev/null&
[1] 2959
root@s11-desktop:~#
```

Here you execute the `find` command with the priority of `60`. What is the highest priority a user can specify for a user-generated process? Refer to Step 4 to determine the highest priority, which is `60`. Refer to man pages for the command options used here.

Use the `ps` command to inspect the priority of the `find` command. Repeat the command multiple times to check if the specified priority is being used at all times.

```
root@s11-desktop:~# ps -ecl | grep find
 0 S      0  2959  2771   TS  59        ?   1865        ? pts/1       0:01
find
root@s11-desktop:~# ps -ecl | grep find
 0 S      0  2959  2771   TS  59        ?   1961        ? pts/1       0:01
find
root@s11-desktop:~# ps -ecl | grep find
 0 R      0  2959  2771   TS  60        ?   1985        ? pts/1       0:02
find
```

Is the designated priority `60` being used at all times? *No, but it is used most of the time. The kernel determines the priority based on what other jobs are running on the CPU; therefore, you might see a slight variance in the specified priority number.*

6. Create a small program to run for a longer duration, so that you can change its priority. Use the `priocntl` command to change the class and specify a time slice or the global priority of the program `modparm`.

Create a small script called `modparm`. Grant the owner the execute permission.

```
root@s11-desktop:~# pfedit modparm
#!/bin/bash
find / -name jholt -exec ls{} \; > /var/tmp/jholt 2<>/dev/null
find / -name jmoose -exec ls{} \; > /var/tmp/jmoose 2<>/dev/null
find / -name awalker -exec ls{} \; > /var/tmp/awalker 2<>/dev/null
find / -name sstudent -exec ls{} \; > /var/tmp/sstudent 2<>/dev/null
find / -name oracle -exec ls{} \; > /var/tmp/oracle 2<>/dev/null
find / -name core -exec ls{} \; > /var/tmp/core 2<>/dev/null
root@s11-desktop:~# ls -l modparm
-rw-r--r--   1 root       root 400 Sep 28 07:28 modparm
root@s11-desktop:~# chmod 755 modparm
root@s11-desktop:~# ls -l modparm
-rwxr-xr-x   1 root       root 404 Sep 28 07:28 modparm

root@s11-desktop:~# priocntl -e -c RT -t 500 -p 20 /root/modparm &
[1] 5104
```

Here you execute your program in the RT class with a time slice of 500 milliseconds, a priority of 20 in the RT class, and a global priority of 120.

7. Verify the designated scheduling class and the priority.

```
root@s11-desktop:~# ps -ecf | grep find
root 10270 10269   RT 120 02:08:08 pts/1      0:05 find / -name jholt -exec
ls{}
```

Is your program running in the designated scheduling class? *Yes*.

Note: To see the continuation of the commands being run in the `modparm` script, continue to run `ps –ecf | grep find`.

8. Use the `priocntl` command to change the priority of the running program `modparm`. Verify the results.

   Note: Make sure that you use the process number that appears on your display. Your process number will be different from the process number (`5104`) presented in the example.

```
root@s11-desktop:~# priocntl -s -p 30 5104
root@s11-desktop:~# ps -ecf | grep find
root 10293 10269  RT 120 02:11:43 pts/1 0:09 find / -name sstudent -exec ls{};
root 10299  1310  TS  29 02:12:04 pts/1 0:00 grep find
```

What are the new RT and global priorities? *They are 30 and 130.*

Note that the system added 100 to 30 to come up with the global priority of 130.

Why would you need to change the priority? *Based on your business process priority, you needed to lower the priority of a long-running transaction.*

9. Copy the `modparm` program to John Holt's home directory so that he can run the program under his privileges. As the administrator, you will change the program's scheduling class by using John's user ID.

As the administrator, execute the following command.

```
root@s11-desktop:~# cp modparm /export/home/jholt
```

As John Holt, execute the following commands.

```
root@s11-desktop:~# su - jholt
Oracle Corporation      SunOS 5.11      11.3     September 2015
jholt@s11-desktop:~$ ls modparm
modparm
jholt@s11-desktop:~$ cp modparm holtparm
jholt@s11-desktop:~$ ls -l holtparm
-rwxr-xr-x   1 jholt    staff        401 Sep 28 15:13 holtparm
```

Note that by copying, it changed the ownership.

Make sure that John has the execute permission on this program. If needed, use the `chmod` command as you did before.

Before you run the program as `jholt`, you need to edit the `/var/tmp` file part of the entry in the `holtparm` file for each user. The user `jholt` does not have the authorization to overwrite the original files but he does have the authorization to overwrite the files he himself has created.

```
jholt@s11-desktop:~$ vi holtparm
#!/bin/bash
find / -name jholt -exec ls{} \; > /var/tmp/holt 2<>/dev/null
find / -name jmoose -exec ls{} \; > /var/tmp/moose 2<>/dev/null
find / -name panna -exec ls{} \; > /var/tmp/walker 2<>/dev/null
```

```
find / -name sstudent -exec ls{} \; > /var/tmp/student
2<>/dev/null
find / -name oracle -exec ls{} \; > /var/tmp/orcl 2<>/dev/null
find / -name core -exec ls{} \; > /var/tmp/cre 2<>/dev/null
~
:wq
```

As John Holt, run the program by using the following command:

```
jholt@s11-desktop:~$ ./holtparm 2<>/dev/null&
[1] 5130
```

You will see some “permission denied” error messages, which you can ignore. The only purpose of the program is to continue running for a while.

10. Now, display the active program as the user John Holt. Finally, use the `pkill -9` command to terminate the processes associated with the `find` command and `modparm` script. Verify that all the processes have been terminated.

```
jholt@s11-desktop:~$ ps -ef | grep holt
   jholt 10328 10315  IA 0 02:17:40 pts/1       0:00 /bin/bash
./holtparm
   jholt 10329 10328  22 02:17:40 pts/1       0:10 find / -name jholt
-exec ls{} ;
   jholt 10335 10315   0 02:18:11 pts/1       0:00 -bash
   jholt 10315  1310   0 02:14:44 pts/1       0:00 -bash
   jholt 10334 10315   1 02:18:11 pts/1       0:00 ps -ef
…
…
…
…
```

When John submitted his job, it ended up in the `TS` class. Why? *The kernel made the call based on the nature of the program and overall workload*.

Determine John’s `userid`.

```
jholt@s11-desktop:~$ exit
logout
root@s11-desktop:~# pkill -9 modparm
root@s11-desktop:~# ps -ef | grep find
root@s11-desktop:~#
```

11. Use the `ps` command to display all the processes running in the `TS` class.

```
root@s11-desktop:~# ps -ef -o class,zone,fname | grep TS | sort
-k2 | more
  TS   global asr-noti
  TS   global automoun
  TS   global automoun
  TS   global bash
  TS   global bash
  TS   global bash
  TS   global bash
  TS   global bash
  TS   global cron
  TS   global cupsd
  TS   global dbus-dae
  TS   global devchass
  TS   global devfsadm
  TS   global dhcpagen
  TS   global dlmgmtd
  TS   global fmd
  TS   global hald
  TS   global hald-add
  TS   global hald-add
  TS   global hald-add
  TS   global hald-run
  TS   global htcachec
  TS   global httpd.wo
  TS   global httpd.wo
  TS   global httpd.wo
  TS   global httpd.wo
  TS   global httpd.wo
  TS   global httpd.wo
  TS   global in.mpath
  TS   global in.ndpd
  TS   global in.route
  TS   global inetd
  TS   global init
  TS   global ipmgmtd
  TS   global iscsid
  TS   global kcfd
  TS   global login
  TS   global mountd
  TS   global named
```

```
TS   global netcfgd
TS   global nfsmapid
TS   global nscd
TS   global nwamd
TS   global pfexecd
TS   global picld
TS   global pkg.depo
TS   global ps
TS   global rad
TS   global reparsed
TS   global rmvolmgr
TS   global rpcbind
TS   global sshd
TS   global sshd
TS   global sshd
TS   global statd
TS   global su
TS   global su
TS   global svc.conf
TS   global svc.star
TS   global sysevent
TS   global syslogd
TS   global ttymon
TS   global ttymon
TS   global ttymon
TS   global ttymon
TS   global ttymon
TS   global utmpd
TS   global vbiosd
TS   global VBoxServ
TS   global vtdaemon
TS   global zoneadmd
TS   global zoneadmd
TS   global zoneprox
TS choczone automoun
TS choczone automoun
TS choczone cron
TS choczone dhcpagen
TS choczone fmd
TS choczone in.mpath
TS choczone in.ndpd
TS choczone in.route
```

```
TS choczone inetd
TS choczone init
TS choczone ipmgmtd
TS choczone kcfd
TS choczone netcfgd
TS choczone nscd
TS choczone nwamd
TS choczone pfexecd
TS choczone rpcbind
TS choczone sendmail
TS choczone sendmail
TS choczone smtp-not
TS choczone sshd
TS choczone svc.conf
TS choczone svc.star
TS choczone syslogd
TS choczone ttymon
TS choczone utmpd
TS choczone zoneprox
TS grandmazone automoun
TS grandmazone automoun
TS grandmazone cron
TS grandmazone dhcpagen
TS grandmazone fmd
TS grandmazone in.mpath
TS grandmazone in.ndpd
TS grandmazone in.route
TS grandmazone inetd
TS grandmazone init
TS grandmazone ipmgmtd
TS grandmazone kcfd
TS grandmazone netcfgd
TS grandmazone nscd
TS grandmazone nwamd
TS grandmazone pfexecd
TS grandmazone rpcbind
TS grandmazone sendmail
TS grandmazone sendmail
TS grandmazone smtp-not
TS grandmazone sshd
TS grandmazone svc.conf
TS grandmazone svc.star
```

```
  TS grandmazone syslogd
  TS grandmazone ttymon
  TS grandmazone utmpd
  TS grandmazone zoneprox
root@s11-desktop:~#
```

Here you display all the processes running on your system that are in the `TS` class.

Note: The output may vary from system to system.

Task 2: Configuring the Fair Share Scheduler

This task will cover the following activities:

- Making `FSS` the default scheduling class
- Moving processes into the `FSS` class
- Moving a project's processes into the `FSS` class
- Tuning scheduler parameters

1. Verify that the Sol11-Desktop VM is running.
2. Use the `dispadmin` command to view and change the default scheduling class to `FSS`. Confirm the action.

```
root@s11-desktop:~# dispadmin -d
dispadmin: Default scheduling class is not set
root@s11-desktop:~# dispadmin -d FSS
root@s11-desktop:~# dispadmin -d
FSS     (Fair Share)
```

Is the default scheduling class changed for the global zone? *Yes.*

Does it mean that `FSS` has become the default scheduling class for all the processes running on the system? *Refer to the display in the following steps.*

3. Use the `dispadmin` command to view the current scheduling classes being used.

```
root@s11-desktop:~# dispadmin -l
CONFIGURED CLASSES
==================

SYS     (System Class)
TS      (Time Sharing)
SDC     (System Duty-Cycle Class)
FSS     (Fair Share)
FX      (Fixed Priority)
IA      (Interactive)
RT      (Real Time)
```

These are all the classes currently being used at this time.

4. Using the `ps` command, display the scheduling class of the currently running processes.

```
root@s11-desktop:~# ps -ef -o class,zone,fname | grep -v CLS |
sort -k2 | more
  TS   global asr-noti
  TS   global auditd
  TS   global automoun
  TS   global automoun
  IA   global bash
  IA   global bash
  IA   global bonobo-a
  IA   global clock-ap
  TS   global console-
  TS   global cron
  TS   global cupsd
  IA   global dbus-dae
  TS   global dbus-dae
  IA   global dbus-lau
  IA   global dbus-lau
  TS   global devchass
  TS   global devfsadm
  TS   global dhcpagen
  TS   global dlmgmtd
  TS   global fmd
 SYS   global fsflush
  IA   global gconfd-2
  TS   global gdm-bina
  IA   global gdm-sess
  IA   global gdm-simp
  IA   global gnome-ke
  IA   global gnome-pa
  IA   global gnome-po
  IA   global gnome-pt
  IA   global gnome-se
  IA   global gnome-se
  IA   global gnome-te
  IA   global gnome-vo
  IA   global grep
  IA   global gvfs-hal
  IA   global gvfsd
  IA   global gvfsd-me
  IA   global gvfsd-tr
  TS   global hald
```

```
 TS   global hald-add
 TS   global hald-add
 TS   global hald-add
 TS   global hald-add
 TS   global hald-run
 TS   global hotplugd
 TS   global htcachec
 TS   global httpd.wo
 TS   global httpd.wo
 TS   global httpd.wo
 TS   global httpd.wo
 TS   global httpd.wo
 TS   global httpd.wo
 TS   global in.mpath
 TS   global in.ndpd
 TS   global in.route
 TS   global inetd
 TS   global init
SYS   global intrd
 TS   global ipmgmtd
 IA   global isapytho
 IA   global isapytho
 TS   global iscsid
 IA   global java
 TS   global kcfd
SDC   global kmem_tas
 IA   global metacity
 IA   global nautilus
 TS   global netcfgd
 TS   global nfsmapid
 IA   global notifica
 IA   global notifica
 TS   global nscd
 IA   global nwam-man
 TS   global nwamd
SYS   global pageout
 TS   global pfexecd
 TS   global picld
 TS   global poold
SDC   global postwait
 IA   global ps
 TS   global rad
```

```
  TS   global rad
  TS   global rmvolmgr
  TS   global rpcbind
 SYS   global sched
  TS   global sendmail
  TS   global sendmail
  TS   global smtp-not
  IA   global ssh-agen
  TS   global sshd
  IA   global su
  TS   global svc.conf
  TS   global svc.star
  TS   global sysevent
  TS   global syslogd
  IA   global trashapp
  TS   global ttymon
  TS   global ttymon
  TS   global ttymon
  TS   global ttymon
  TS   global ttymon
  TS   global ttymon
  IA   global updatema
  TS   global utmpd
  TS   global vbiosd
  IA   global VBoxClie
  IA   global VBoxClie
  IA   global VBoxClie
  IA   global VBoxClie
  TS   global VBoxServ
 SYS   global vmtasks
  TS   global vtdaemon
  IA   global wnck-app
  IA   global Xorg
  IA   global xscreens
  TS   global zoneadmd
  TS   global zoneadmd
  TS   global zoneprox
  FX   global zonestat
 SDC   global zpool-rp
  TS choczone automoun
  TS choczone automoun
  TS choczone cron
```

```
  TS choczone dbus-dae
  TS choczone fmd
  TS choczone in.mpath
  TS choczone in.ndpd
  TS choczone in.route
  TS choczone inetd
  TS choczone init
  TS choczone ipmgmtd
  TS choczone kcfd
  TS choczone netcfgd
  TS choczone nscd
  TS choczone nwamd
  TS choczone pfexecd
  TS choczone rad
  TS choczone rpcbind
  TS choczone sendmail
  TS choczone sendmail
  TS choczone smtp-not
  TS choczone sshd
  TS choczone svc.conf
  TS choczone svc.star
  TS choczone syslogd
  TS choczone ttymon
  TS choczone utmpd
  TS choczone zoneprox
 SYS choczone zsched
  TS grandmazone automoun
  TS grandmazone automoun
  TS grandmazone cron
  TS grandmazone dbus-dae
  TS grandmazone dhcpagen
  TS grandmazone fmd
  TS grandmazone in.mpath
  TS grandmazone in.ndpd
  TS grandmazone in.route
  TS grandmazone inetd
  TS grandmazone init
  TS grandmazone ipmgmtd
  TS grandmazone kcfd
  TS grandmazone netcfgd
  TS grandmazone nscd
  TS grandmazone nwamd
```

```
  TS grandmazone pfexecd
  TS grandmazone rad
  TS grandmazone rpcbind
  TS grandmazone sendmail
  TS grandmazone sendmail
  TS grandmazone smtp-not
  TS grandmazone sshd
  TS grandmazone svc.conf
  TS grandmazone svc.star
  TS grandmazone syslogd
  TS grandmazone ttymon
  TS grandmazone utmpd
  TS grandmazone zoneprox
 SYS grandmazone zsched
```

Note: The output may vary from system to system.

What are some of the classes being used at this time? *TS, IA, and SYS*

5. Use the `priocntl` command to move all current processes into the `FSS` class.

```
root@s11-desktop:~# priocntl -s -c FSS -i all
```

Why did you have to move all the current processes to the `FSS` class manually when you already set the default class to `FSS`? *Because the new default class is effective on next reboot. It does not affect the currently active processes.*

6. Using the `ps` command, display the modified scheduling class of the currently running processes.

```
root@s11-desktop:~# ps -ef -o class,zone,fname | grep -v CLS |
sort -k2 | more
 FSS   global asr-noti
 FSS   global auditd
 FSS   global automoun
 FSS   global automoun
 FSS   global bash
 FSS   global bash
 FSS   global bonobo-a
 FSS   global clock-ap
 FSS   global console-
 FSS   global cron
 FSS   global cupsd
 FSS   global dbus-dae
 FSS   global dbus-dae
 FSS   global dbus-lau
 FSS   global dbus-lau
```

```
FSS   global devchass
FSS   global devfsadm
FSS   global dhcpagen
FSS   global dlmgmtd
FSS   global fmd
SYS   global fsflush
FSS   global gconfd-2
FSS   global gdm-bina
FSS   global gdm-sess
FSS   global gdm-simp
FSS   global gnome-ke
FSS   global gnome-pa
FSS   global gnome-po
FSS   global gnome-pt
FSS   global gnome-se
FSS   global gnome-se
FSS   global gnome-te
FSS   global gnome-vo
FSS   global grep
FSS   global gvfs-hal
FSS   global gvfsd
FSS   global gvfsd-me
FSS   global gvfsd-tr
FSS   global hald
FSS   global hald-add
FSS   global hald-add
FSS   global hald-add
FSS   global hald-add
FSS   global hald-run
FSS   global hotplugd
FSS   global htcachec
FSS   global httpd.wo
FSS   global httpd.wo
FSS   global httpd.wo
FSS   global httpd.wo
FSS   global httpd.wo
FSS   global httpd.wo
FSS   global in.mpath
FSS   global in.ndpd
FSS   global in.route
FSS   global inetd
 TS   global init
```

```
SYS   global intrd
FSS   global ipmgmtd
FSS   global isapytho
FSS   global isapytho
FSS   global iscsid
FSS   global java
FSS   global kcfd
SDC   global kmem_tas
FSS   global metacity
FSS   global more
FSS   global nautilus
FSS   global netcfgd
FSS   global nfsmapid
FSS   global notifica
FSS   global notifica
FSS   global nscd
FSS   global nwam-man
FSS   global nwamd
SYS   global pageout
FSS   global pfexecd
FSS   global picld
FSS   global poold
SDC   global postwait
FSS   global ps
FSS   global rad
FSS   global rad
FSS   global rmvolmgr
FSS   global rpcbind
SYS   global sched
FSS   global sendmail
FSS   global sendmail
FSS   global smtp-not
FSS   global sort
FSS   global ssh-agen
FSS   global sshd
FSS   global su
FSS   global svc.conf
FSS   global svc.star
FSS   global sysevent
FSS   global syslogd
FSS   global trashapp
FSS   global ttymon
```

```
FSS   global ttymon
FSS   global ttymon
FSS   global ttymon
FSS   global ttymon
FSS   global ttymon
FSS   global updatema
FSS   global utmpd
FSS   global vbiosd
FSS   global VBoxClie
FSS   global VBoxClie
FSS   global VBoxClie
FSS   global VBoxClie
FSS   global VBoxServ
SYS   global vmtasks
FSS   global vtdaemon
FSS   global wnck-app
FSS   global Xorg
FSS   global xscreens
FSS   global zoneadmd
FSS   global zoneadmd
FSS   global zoneprox
FSS   global zonestat
SDC   global zpool-rp
FSS choczone automoun
FSS choczone automoun
FSS choczone cron
FSS choczone dbus-dae
FSS choczone fmd
FSS choczone in.mpath
FSS choczone in.ndpd
FSS choczone in.route
FSS choczone inetd
FSS choczone init
FSS choczone ipmgmtd
FSS choczone kcfd
FSS choczone netcfgd
FSS choczone nscd
FSS choczone nwamd
FSS choczone pfexecd
FSS choczone rad
FSS choczone rpcbind
FSS choczone sendmail
```

```
 FSS choczone sendmail
 FSS choczone smtp-not
 FSS choczone sshd
 FSS choczone svc.conf
 FSS choczone svc.star
 FSS choczone syslogd
 FSS choczone ttymon
 FSS choczone utmpd
 FSS choczone zoneprox
 SYS choczone zsched
 FSS grandmazone automoun
 FSS grandmazone automoun
 FSS grandmazone cron
 FSS grandmazone dbus-dae
 FSS grandmazone dhcpagen
 FSS grandmazone fmd
 FSS grandmazone in.mpath
 FSS grandmazone in.ndpd
 FSS grandmazone in.route
 FSS grandmazone inetd
 FSS grandmazone init
 FSS grandmazone ipmgmtd
 FSS grandmazone kcfd
 FSS grandmazone netcfgd
 FSS grandmazone nscd
 FSS grandmazone nwamd
 FSS grandmazone pfexecd
 FSS grandmazone rad
 FSS grandmazone rpcbind
 FSS grandmazone sendmail
 FSS grandmazone sendmail
 FSS grandmazone smtp-not
 FSS grandmazone sshd
 FSS grandmazone svc.conf
 FSS grandmazone svc.star
 FSS grandmazone syslogd
 FSS grandmazone ttymon
 FSS grandmazone utmpd
 FSS grandmazone zoneprox
 SYS grandmazone zsched
root@s11-desktop:~#
```

Note: The output may vary from system to system.

Are all the processes using `FSS`? *No; however, most of the processes are using `FSS`.*

Why are some of the processes in the `TS`, `SDC`, and `SYS` classes? *The classes remain unchanged for these processes based on the nature of the processes. For example, the `zsched` daemon normally runs in the `SYS` class because of its scope.*

7. Using the `ps` command, display all the `init` processes.

```
root@s11-desktop:~# ps -ecf | grep init
    root     1     0   TS  59 10:54:11 ?           0:00 /usr/sbin/init
    root  2487  1562  FSS  29 11:00:37 ?           0:00 /usr/sbin/init
    root  2491  1406  FSS  29 11:00:37 ?           0:00 /usr/sbin/init
    root  5981  5821  FSS  59 07:20:48 pts/1       0:00 grep init
```

Why are there so many `init` processes? *One for each zone. Refer to the display in Step 6.*

8. Using the `priocntl` command, change the class of the `init` process to the `FSS` scheduling class. Display the classes of all the `init` processes to confirm the change.

```
root@s11-desktop:~# priocntl -s -c FSS -i pid 1
root@s11-desktop:~# ps -ef -o class,zone,fname | grep init
 FSS   global init
 FSS zone2 init
 FSS choczone init
 FSS grandmazone init
```

Did you change the classes for all the `init` processes*? No, only for the global zone because you specified PID `1`.*

9. Now change a project's scheduling class. First, by using the `ps` command, find the current class for the current projects.

```
root@s11-desktop:~# ps -o user,pid,uid,projid,project,class
    USER   PID UID PROJID   PROJECT  CLS
    root  1309   0      1 user.root  FSS
    root  1310   0      1 user.root  FSS
    root 10415   0      1 user.root  FSS
```

Because you changed the scheduling class for all the processes, the `user.root` project and its processes are running in the FSS class. So, where can you find the definition of this project? *The definition can be found in the `/etc/project` file.*

Note: The project topic is covered here only in the context of a scheduling class.

```
root@s11-desktop:~# grep user.root /etc/project
user.root:1::::
root@s11-desktop:~# priocntl -s -c TS -i projid 1
root@s11-desktop:~# ps -o user,pid,uid,projid,project,class
    USER   PID   UID PROJID  PROJECT   CLS
    root  5142     0      1 user.root   TS
    root  5189     0      1 user.root   TS
```

```
    root 10412      0      1 user.root    TS
```

Did you change the scheduling class for all the processes? *No.*

How would you confirm that? *Refer to the commands in the preceding steps.*

What would prompt this action of changing the project class? *You want to change the scheduling class based on the importance of a project.*

10. Use the `dispadmin` command to inspect the current scheduler parameter `quantum` value. Modify the value and verify the change.

Refer to Task1, Step 7 where you used `-t 500` to set a quantum value for the task. In the following steps, you change the time quantum unit to, for example, one-tenth and one-hundredth of a second.

```
root@s11-desktop:~# dispadmin -c FSS -g
#
# Fair Share Scheduler Configuration
#
RES=1000
#
# Time Quantum
#
QUANTUM=110
```

Currently, the quantum values are specified in 1/1000th of a second. You can change it to 1/100th of a second.

```
root@s11-desktop:~# dispadmin -c FSS -g -r 100
#
# Fair Share Scheduler Configuration
#
RES=100
#
# Time Quantum
#
QUANTUM=11
```

Why would you need to change these values? *When you want to work with smaller digits (specifying 10 is a lot easier than 100000 for quantum values*).

Now reboot S11-Desktop VM to make your changes effective.

```
root@s11-desktop:~# init 6
```

Practice 9-2: Configuring the FSS in an Oracle Solaris Zone

Overview

Your predeployment test plan calls for configuring the CPU shares and the scheduling class FSS for the `grandmazone` and the `choczone` nonglobal zones. This practice will demonstrate the effect of using CPU shares in an attempt to constrain the resources.

The following tasks are covered in this practice:

- Configuring CPU shares and the FSS
- Monitoring the FSS in two zones
- Removing the CPU shares configuration

Task 1: Configuring the CPU Shares and the FSS

1. Verify that the Sol11-Desktop VM is running and assume the `root` role.
2. Use the `zoneadm list` command to view the configured zones.

```
root@s11-desktop:~# zoneadm list -civ
  ID NAME             STATUS     PATH                         BRAND      IP
   0 global           running    /                            solaris    shared
   1 grandmazone      running    /zones/grandmazone           solaris    excl
   2 choczone         running    /zones/choczone              solaris    excl
   - zone2            installed  /zones/zone2                 solaris10  excl
```

If you recall, you had configured these zones earlier in the class.

Note: If you see the `zone2` zone in running state, halt it by using the `zoneadm –z zone2 halt` command.

3. Use the `zonecfg` command to add the CPU shares to `grandmazone`. Display the results to confirm the action.

```
root@s11-desktop:~# zonecfg -z grandmazone
zonecfg:grandmazone> set cpu-shares=80
zonecfg:grandmazone> exit
root@s11-desktop:~# zonecfg -z grandmazone info | more
zonename: grandmazone
zonepath: /zones/grandmazone
brand: solaris
autoboot: true
autoshutdown: shutdown
bootargs:
file-mac-profile:
pool:
limitpriv:
scheduling-class:
ip-type: exclusive
hostid:
```

```
tenant:
fs-allowed:
[cpu-shares: 80]
net:
        address not specified
        allowed-address not specified
        configure-allowed-address: true
        physical: vnic1
        defrouter not specified
anet:
        linkname: net0
        lower-link: auto
        allowed-address not specified
        configure-allowed-address: true
        defrouter not specified
        allowed-dhcp-cids not specified
        link-protection: mac-nospoof
        mac-address: random
        auto-mac-address: 2:8:20:e4:e8:68
        mac-prefix not specified
        mac-slot not specified
        vlan-id not specified
        priority not specified
        rxrings not specified
        txrings not specified
        mtu not specified
        maxbw not specified
        rxfanout not specified
        vsi-typeid not specified
        vsi-vers not specified
        vsi-mgrid not specified
        etsbw-lcl not specified
        cos not specified
        pkey not specified
        linkmode not specified
        evs not specified
        vport not specified
rctl:
        name: zone.cpu-shares
        value: (priv=privileged,limit=80,action=none)
```

Note the CPU shares–related entries.

4. Repeat step 3 for the second zone, namely, `choczone`.

```
root@s11-desktop:~# zonecfg -z choczone
zonecfg:choczone> set cpu-shares=10
zonecfg:choczone> exit
root@s11-desktop:~# zonecfg -z choczone info | more
zonename: choczone
zonepath: /zones/choczone
brand: solaris
autoboot: true
autoshutdown: shutdown
bootargs:
file-mac-profile:
pool:
limitpriv:
scheduling-class:
ip-type: exclusive
hostid:
tenant:
fs-allowed:
[cpu-shares: 10]
net:
        address not specified
        allowed-address not specified
        configure-allowed-address: true
        physical: vnic2
        defrouter not specified
anet:
        linkname: net0
        lower-link: auto
        allowed-address not specified
        configure-allowed-address: true
        defrouter not specified
        allowed-dhcp-cids not specified
        link-protection: mac-nospoof
        mac-address: random
        auto-mac-address: 2:8:20:b3:6f:61
        mac-prefix not specified
        mac-slot not specified
        vlan-id not specified
        priority not specified
        rxrings not specified
        txrings not specified
```

```
        mtu not specified
        maxbw not specified
        rxfanout not specified
        vsi-typeid not specified
        vsi-vers not specified
        vsi-mgrid not specified
        etsbw-lcl not specified
        cos not specified
        pkey not specified
        linkmode not specified
        evs not specified
        vport not specified
rctl:
        name: zone.cpu-shares
        value: (priv=privileged,limit=10,action=none)
```

Notice the number of CPU shares allocated to this zone.

5. Use the `zlogin` command to cleanly reboot both the zones. Verify that they are back up and running.

```
root@s11-desktop:~# zlogin grandmazone init 6
root@s11-desktop:~# zlogin choczone init 6
root@s11-desktop:~# zoneadm list -civ
  ID NAME             STATUS     PATH                           BRAND    IP
   0 global           running    /                              solaris  shared
   2 grandmazone      running    /zones/grandmazone             solaris  excl
   3 choczone         running    /zones/choczone                solaris  excl
   …
```

How can you tell they have been rebooted? *The zone IDs are different.*

6. Now examine the effect of CPU share assignment. Log in to each zone and create the tasks as indicated.

```
root@s11-desktop:~# zlogin grandmazone
[Connected to zone 'grandmazone' pts/2]
Oracle Corporation    SunOS 5.11     11.3       September 2015
root@grandmazone:~# newtask dd if=/dev/zero of=/dev/null &
[1] 7949
root@grandmazone:~# ps -ef | grep 7949
    root  7949  7945  34 03:12:42 pts/2       0:21 dd if=/dev/zero
of=/dev/null
    root  7953  7945   0 03:13:55 pts/2       0:00 grep 7949
root@grandmazone:~# exit
logout
```

```
[Connection to zone 'grandmazone' pts/2 closed]
```

Start a similar task in `choczone`.

```
root@s11-desktop:~# zlogin choczone
[Connected to zone 'choczone' pts/3]
Oracle Corporation    SunOS 5.11     11.3       September 2015
root@choczone:~# newtask dd if=/dev/zero of=/dev/null &
[1] 7959
root@choczone:~# ps -ef | grep 7959
    root  7959  7955   8 03:15:12 pts/3       0:08 dd
if=/dev/zero of=/dev/null
    root  7961  7955   0 03:15:14 pts/3       0:00 grep 7959
root@choczone:~# exit
logout

[Connection to zone 'choczone' pts/2 closed]
```

The `newtask` command starts a task that is an infinite loop. These tasks will be used to demonstrate the CPU resource utilization by the Oracle Solaris kernel.

7. Use the `ps` command from the global zone to verify that the task from `choczone` is running in the FSS class.

```
root@s11-desktop:~# ps -ecf | grep 7949
    root  7967  3467  FSS  59 03:16:04 console     0:00 grep 7949
    root  7949     1  FSS   1 03:12:42 ?           2:31 dd
if=/dev/zero of=/dev/null
root@s11-desktop:~# ps -ecf | grep 7959
    root  8430     1  FSS   1 03:15:01 ?           0:11 dd
if=/dev/zero of=/dev/null
    root  9432     1  FSS   1 03:17:34 ?           0:00 grep 7959
root@s11-desktop:~# ps -ecf | grep 7959
    root  8430     1  FSS   6 03:15:01 ?           0:13 dd
if=/dev/zero of=/dev/null
    root  9432     1  FSS   1 03:17:34 ?           0:00 grep 7959
root@s11-desktop:~# ps -ecf | grep 7959
    root  8430     1  FSS   1 03:15:01 ?           0:16 dd
if=/dev/zero of=/dev/null
    root  9432     1  FSS   1 03:17:34 ?           0:00 grep 7959
```

Is the task running in the FSS zone? *Yes.*

How and why? *Because earlier you set the default class to `FSS` for the whole system.*
Check the scheduling class for the task running in `grandmazone`.

8. From the global zone, use the `prstat -Z` command to measure CPU performance.

```
root@s11-desktop:~# prstat -Z
PID USERNAME  SIZE   RSS STATE   PRI NICE      TIME  CPU PROCESS/NLWP
----------------------------------------------------------------------
 10785 root     8580K 1128K run      34    0   0:06:37  42% dd/1
 10948 root     8580K 1108K run       1    0   0:00:46 5.8% dd/1
 11105 root       11M 3268K cpu1     59    0   0:00:00 0.2% prstat/1
  4521 oracle    128M   18M run      54    0   0:00:03 0.1% gnome-terminal/2
   953 oracle     71M   46M run      47    0   0:00:07 0.1% Xorg/3
   619 root       61M   20M sleep    59    0   0:00:04 0.1% poold/9
  4002 oracle     13M 2352K sleep    59    0   0:00:03 0.1% VBoxClient/3
  3313 oracle     30M   14M sleep    59    0   0:00:00 0.0% metacity/1
  4554 root       10M 2296K sleep    59    0   0:00:00 0.0% bash/1
     5 root        0K    0K sleep    99  -20   0:00:11 0.0% zpool-rpool/137
  3601 oracle    147M   31M sleep    59    0   0:00:01 0.0% nautilus/1
   587 root       11M 1644K sleep    59    0   0:00:00 0.0% VBoxService/7
  4053 oracle     65M   37M sleep    59   19   0:00:01 0.0% updatemanagerno/1
  4032 oracle    135M   21M sleep    59    0   0:00:00 0.0% isapython2.6/1
  3920 oracle     13M 4684K sleep    59    0   0:00:00 0.0% xscreensaver/1
ZONEID    NPROC  SWAP   RSS MEMORY      TIME  CPU ZONE
----------------------------------------------------------------------------
     3       31   56M   59M   2.9%   0:07:28  42% grandmazone
     4       30   56M   60M   2.9%   0:01:37 5.8% choczone
     0      112  401M  347M    17%   0:02:58 0.8% global

Total: 173 processes, 908 lwps, load averages: 2.81, 3.70, 3.61

…
…
<Press q to quit>
```

To get a true picture, you need to watch the dynamic display for a few minutes. You will see it getting closer and closer to the ratio you specified. (Recall from the lesson the difference between CPU shares and CPU percentage.)

Convert the CPU shares to percentages and compare with the average CPU utilization here.

What column do you need to watch? *The `CPU` column*

Note that there is more CPU utilization by `grandmazone` as compared to `choczone`.

Why? *This is the effect of the CPU shares allocation.*

9. Use the `prctl` command to assign 40 CPU shares to the global zone.

```
root@s11-desktop:~# prctl -n zone.cpu-shares -v 40 -r -i zone global
```

Note that you can modify the attributes of the global zone, too.

10. Start a new task from the global zone.

```
root@s11-desktop:~# newtask dd if=/dev/zero of=/dev/null&
[1] 10444
```

11. Observe the results by running the `prstat` command.

```
root@s11-desktop:~# prstat -Z
   PID USERNAME  SIZE   RSS STATE   PRI NICE      TIME  CPU PROCESS/NLWP
------------------------------------------------------------------------------
 10785 root     8580K 1128K run      14    0   0:11:08  30% dd/1
 11108 root     8580K 1140K run      20    0   0:00:29  13% dd/1
 10948 root     8580K 1108K run       1    0   0:01:31 4.2% dd/1
 11110 root       11M 3260K cpu1     59    0   0:00:00 0.2% prstat/1
   953 oracle     71M   46M run      39    0   0:00:08 0.2% Xorg/3
  4521 oracle    128M   18M run      41    0   0:00:04 0.1% gnome-terminal/2
   619 root       61M   20M run      59    0   0:00:05 0.1% poold/9
  4002 oracle     13M 2352K run      59    0   0:00:04 0.1% VBoxClient/3
     5 root        0K    0K sleep    99  -20   0:00:11 0.0% zpool-rpool/137
  4554 root       10M 2296K sleep    59    0   0:00:00 0.0% bash/1
  3313 oracle     30M   14M sleep    45    0   0:00:00 0.0% metacity/1
  3920 oracle     13M 4684K sleep    59    0   0:00:00 0.0% xscreensaver/1
   587 root       11M 1644K sleep    59    0   0:00:00 0.0% VBoxService/7
  4053 oracle     65M   37M sleep    59   19   0:00:01 0.0% updatemanagerno/1
  4032 oracle    135M   21M sleep    59    0   0:00:01 0.0% isapython2.6/1
ZONEID    NPROC  SWAP   RSS MEMORY      TIME  CPU ZONE
------------------------------------------------------------------------------
     0      113  401M  347M    17%   0:03:32  14% global
     3       31   56M   59M   2.9%   0:11:59  30% grandmazone
     4       30   56M   60M   3.0%   0:02:22 4.2% choczone
Total: 174 processes, 909 lwps, load averages: 2.95, 3.01, 3.30
…
…
<Press q to quit>
```

Repeat the analysis you did in Step 10, but this time pay attention to the global zone CPU consumption. Remember to observe the changing CPU utilization for a few minutes to obtain an approximate average.

Compare the shares allocation and the percentages.

12. Abort all the infinite processes.

```
root@s11-desktop:~# pkill -9 dd
root@s11-desktop:~# pkill -9 find
[1]+  Killed                  newtask dd if=/dev/zero of=/dev/null
```

Task 2: Removing the CPU Shares Configuration

1. Verify that the Sol11-Desktop VM is running.
2. Use the `zonecfg` command to view the current CPU shares configuration of the zone named `grandmazone`.

```
root@s11-desktop:~# zonecfg -z grandmazone info
zonename: grandmazone
zonepath: /zones/grandmazone
brand: solaris
autoboot: true
autoshutdown: shutdown
bootargs:
file-mac-profile:
pool:
limitpriv:
scheduling-class:
ip-type: exclusive
hostid:
fs-allowed:
tenant:
[cpu-shares: 80]
net:
        address not specified
        allowed-address not specified
        configure-allowed-address: true
        physical: vnic1
        defrouter not specified
anet:
        linkname: net0
        lower-link: auto
        allowed-address not specified
        configure-allowed-address: true
        defrouter not specified
        allowed-dhcp-cids not specified
        link-protection: mac-nospoof
        mac-address: random
        auto-mac-address: 2:8:20:7b:1a:a1
        mac-prefix not specified
        mac-slot not specified
        vlan-id not specified
        priority not specified
        rxrings not specified
        txrings not specified
```

```
        mtu not specified
        maxbw not specified
        rxfanout not specified
        vsi-typeid not specified
        vsi-vers not specified
        vsi-mgrid not specified
        etsbw-lcl not specified
        cos not specified
        pkey not specified
        linkmode not specified
        evs not specified
        vport not specified

rctl:
        name: zone.cpu-shares
        value: (priv=privileged,limit=80,action=none)
```

Notice the CPU configuration.

3. Use the `zonecfg` command to delete the CPU configuration. Verify the action.

```
root@s11-desktop:~# zonecfg -z grandmazone clear cpu-shares
root@s11-desktop:~# zonecfg -z grandmazone info
zonename: grandmazone
zonepath: /zones/grandmazone
brand: solaris
autoboot: true
autoshutdown: shutdown
bootargs:
file-mac-profile:
pool:
limitpriv:
scheduling-class:
ip-type: exclusive
hostid:
tenant:
fs-allowed:
net:
        address not specified
        allowed-address not specified
        configure-allowed-address: true
        physical: vnic1
        defrouter not specified
anet:
```

```
         linkname: net0
         lower-link: auto
         allowed-address not specified
         configure-allowed-address: true
         defrouter not specified
         allowed-dhcp-cids not specified
         link-protection: mac-nospoof
         mac-address: random
         auto-mac-address: 2:8:20:34:6e:84
         mac-prefix not specified
         mac-slot not specified
         vlan-id not specified
         priority not specified
         rxrings not specified
         txrings not specified
         mtu not specified
         maxbw not specified
         rxfanout not specified
         vsi-typeid not specified
         vsi-vers not specified
         vsi-mgrid not specified
         etsbw-lcl not specified
         cos not specified
         pkey not specified
         linkmode not specified
         evs not specified
         vport not specified
```

Notice that the `cpu-shares` entry is deleted.

4. Repeat step 3 for the second zone, namely, `choczone`.

```
root@s11-desktop:~# zonecfg -z choczone clear cpu-shares
root@s11-desktop:~# zonecfg -z choczone info | grep cpu-shares
```

To make the configuration effective, do you need to reboot the zones? *Yes.*
The zones will be rebooted as part of step 6.

5. Reset the system default scheduling class by using the `dispadmin` command. Verify the change.

```
root@s11-desktop:~# dispadmin -d
FSS (Fair Share)
root@s11-desktop:~# dispadmin -d TS
root@s11-desktop:~# dispadmin -d
TS   (Time Sharing)
root@s11-desktop:~# priocntl -s -c TS -i all
```

Have you verified that all system processes have been moved to the `TS` class? *Yes.*

6. Reboot the system by using the `init 6` command. By rebooting the entire system, the global CPU share property is cleared. In addition, the global zone has the new default scheduling class (`TS`). As part of the reboot, the zones are rebooted automatically so their CPU share properties are also cleared. After the reboot is completed, the new configuration will be in place.

Practices for Lesson 10: Installing Oracle Solaris 11 on Multiple Hosts

Chapter 10

Practices for Lesson 10: Overview

Practices Overview

According to the predeployment plan and checklist, you will now start configuring the Automated Installer (AI). The AI configuration practices help you to understand how you can save time and resources while installing Oracle Solaris 11 on multiple client hosts individually.

This practice covers the following tasks:

- Verifying the AI system requirements
- Configuring the AI server
- Deploying the OS on the network client
- Configuring Oracle Solaris 11 instances
- Customizing the Automated Installation

	Oracle Solaris 11 Predeployment Checklist
✓	Managing Services and Service Properties by Using SMF
✓	Managing Software Packages by Using IPS
✓	Managing Data Backup and Restore by Using ZFS
✓	Configuring the Network
✓	Administering Network Services
✓	Advanced Administration of Zones
✓	Securing the Oracle Solaris 11 OS
✓	Managing Processes and Priorities
	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

In the following practices, you install Oracle Solaris 11 OS on an x86/64 machine in an automated, unattended manner. Your first task is to verify that the system meets the AI requirements. In the second task, you configure the AI on a server. Then as a final step, you deploy the OS on a network client.

Before you install the Oracle Solaris 11 OS by using AI, you must first download the Oracle Solaris 11 AI installation image from the following site:

http://www.oracle.com/technetwork/server-storage/solaris11/downloads/index.html.

The AI installation download is in an ISO image format that can be burned to a CD or DVD, or used directly within Oracle VM Server or other virtualization software.

> **Note:** For training purposes, the AI ISO has already been downloaded for you. The ISO image file can be found in the `/opt/ora/iso` directory of the S11-Server1 VM.

Practice 10-1: Verifying the System AI Requirements

Overview

This practice takes you through the steps for checking the existing version of Oracle Solaris 11 to verify the system requirements for the AI installation. For the purposes of AI configuration, you need to configure the IPS repository on the local VM (S11-Server1) so that you can minimize the package deployment.

Notes

- This practice is included here as a checkpoint prerequisite because you need to ensure that the IPS repository is properly configured and DNS multicast is enabled before you configure AI.
- Your command output displays may be different from the displays in the practice, especially allocation and utilization, process IDs, and similar information.

Tasks

1. Shut down the S11-Desktop virtual machine.
2. Verify that the S11-Server1 virtual machine is running. If it is not running, then log in to the virtual machine as the `oracle` user. Use the password `oracle1`. Assume administrator privileges.

```
oracle@s11-server1:~$ su -
Password: oracle1
Oracle Corporation   SunOS 5.11      11.3      September 2015
root@s11-server1:~#
```

3. Verify that the operating system is Oracle Solaris 11.3 release.

```
root@s11-server1:~# cat /etc/release
                             Oracle Solaris 11.3 X86
  Copyright (c) 1983, 2015, Oracle and/or its affiliates.  All rights reserved.
                             Assembled 21 October 2015
```

4. Verify that the operating system is configured with a static IP address.

```
root@s11-server1:~# svcs network/physical:default
STATE          STIME    FMRI
online         0:24:39   svc:/network/physical:default
root@s11-server1:~# ipadm show-addr
ADDROBJ            TYPE     STATE        ADDR
…
net0/v4          static   ok           192.168.1.100/24
…
```

5. Verify that DNS is operational.

```
root@s11-server1:~# nslookup s11-server1.example.com
Server:         192.168.1.100
Address:        192.168.1.100#53

Name:   s11-server1.example.com
Address: 192.168.1.100
```

6. List the configured package publisher.

```
root@s11-server1:~# pkg publisher
PUBLISHER     TYPE     STATUS P LOCATION
solaris      origin    online F http://s11-server1.example.com:10000/
```

7. Check whether the `svc:/network/dns/multicast` service is online. If the service is not online, enable it.

```
root@s11-server1:~# svcs network/dns/multicast
STATE          STIME    FMRI
disabled       1:08:14  svc:/network/dns/multicast:default
root@s11-server1:~# svcadm enable network/dns/multicast:default
root@s11-server1:~# svcs network/dns/multicast
STATE          STIME    FMRI
online         1:32:27 svc:/network/dns/multicast:default
root@s11-server1:~# svcs | grep dns
online         5:05:05 svc:/network/dns/client:default
online         5:05:08 svc:/network/dns/server:default
online         5:26:41 svc:/network/dns/multicast:default
```

8. Verify that the `netmasks` file is configured appropriately for the DHCP service.

```
root@s11-server1:~# getent netmasks 192.168.1.0
root@s11-server1:~#
```

Note: DHCP requires that the network mask for the local subnet be configured in the `/etc/netmasks` file. If an entry does not exist, update the `netmasks` file now.

```
root@s11-server1:~# pfedit /etc/netmasks
…
192.168.1.0 255.255.255.0

root@s11-server1:~# getent netmasks 192.168.1.0
192.168.1.0          255.255.255.0
```

Practice 10-2: Configuring the AI Server

Overview

After you have verified that the server meets the AI requirements, you are ready to configure the AI server. After the configuration is complete, you will be able to install the Oracle Solaris 11.3 OS on one or more client hosts. This practice will set up a DHCP server as part of the configuration. This DHCP server allocates an IP address to the client host.

Notes

- Because you are not using the default IPS service, you will need to adjust the default AI service accordingly.
- Perform all steps carefully. Any syntax error made while configuring the AI server may lead to unsuccessful installation of clients.

Tasks

To configure the AI server on the S11-Server1 virtual machine, perform the following steps:

1. Create a directory for your AI server.

```
root@s11-server1:~# mkdir –p /export/ai/basic_ai
```

2. Set the DHCP server to be managed by the AI server with the following values:
   - DHCP base IP address: 192.168.1.130
   - DHCP IP address range: 20

```
root@s11-server1:~# installadm set-server -i 192.168.1.130 -c 20 -m
Creating DHCP server configuration file
Adding DHCP IP range: 192.168.1.130 [20]
Unable to determine a route for network 192.168.1.0. Setting the route
temporarily to 0.0.0.0; this should be changed to an appropriate value
in the DHCP configuration file. Please see dhcpd(8) for further
information.
Warning: AI server will now manage DHCP
Changed Server
Enabling SMF service svc:/network/dhcp/server:ipv4
```

3. Use the `installadm create-service` command to create an AI service based on the following information:
   - Service name: `basic_ai`
   - AI ISO image location: `/opt/ora/iso/sol-11_3-ai-x86.iso`
   - Target directory: `/export/ai/basic_ai`

```
root@s11-server1:~# installadm create-service -n basic_ai
-s /opt/ora/iso/sol-11_3-ai-x86.iso -d /export/ai/basic_ai
  0% : Creating service from /opt/ora/iso/sol-11_3-ai-x86.iso
 33% : Transferring contents
 33% : Creating i386 service: basic_ai
 33% : Image path: /export/ai/basic_ai
 33% : Setting “solaris” publisher URL in default manifest to:
 33% : http://s11-server1.example.com/
```

```
 33% : SMF Service 'svc:/system/install/server:default' will be
enabled.
 33% : SMF Service 'svc:/system/network/tftp/udp6:default' will
be enabled.
 33% : Creating default-i386 alias
 33% : Setting "solaris" publisher URL in default manifest to:
 33% :  http://s11-server1.example.com/
 33% : Setting the default PXE bootfiles(s) in the local DHCP
configuration to:
 33% :    bios clients (arch 00:00): default-
i386/boot/grub/pxegrub2
 33% :    uefi clients (arch 00:07): default-
i386/boot/grub/grub2netc64.efi
 33% :
 33% : SMF Service 'svc:/system/install/server:default' will be
enabled
 33% : SMF Service 'svc:/network/tftp/udp6:default' will be
enabled
100% : Created Service: 'basic_ai'
100% : Refreshing SMF Service svc:/system/install/server:default
100% : Refreshing SMF Service svc:/network/tftp/udp6:default
100% : Refreshing SMF Service svc:/network/dhcp/server:ipv4
100% : Enabling SMF Service svc:/network/udp6:default
100% : Enabling SMF Service svc:/network/install/server:default
100% : Service 'basic_ai' has been added to the mDNS registry
100% : Service 'default-i386' has been added to the mDNS
registry
```

Note: You can remove an AI service and associated clients by using the `installadm delete-service -r` *`svcname`* command.

4. Verify that a DHCP service is available.

```
root@s11-server1:~# svcs svc:/network/dhcp/server
STATE                STIME      FMRI
disabled             0:41:18   svc:/network/dhcp/server:ipv6
online               10:52:10   svc:/network/dhcp/server:ipv4
root@s11-server1:~# cat /etc/inet/dhcpd4.conf | more
# dhcpd.conf
#
# Configuration file for ISC dhcpd
# (created by installadm(1M))
#

default-lease-time 900;
max-lease-time 86400;
```

```
# If this DHCP server is the official DHCP server for the local
# network, the authoritative directive should be uncommented.
authoritative;
# arch option for PXEClient
option arch code 93 = unsigned integer 16;

# Set logging facility (accompanies setting in syslog.conf)
log-facility local7;

# Global name services
option domain-name-servers 192.168.1.100;
option domain-search "example.com";
option nis-domain "['example.com']";


subnet 192.168.1.0 netmask 255.255.255.0 {
     range 192.168.1.130 192.168.1.149;
     option broadcast-address 192.168.1.255;
     option routers 0.0.0.0;
     next-server 192.168.1.100;
}
class "PXEBoot" {
  match if (substring(option vendor-class-identifier, 0, 9) =
"PXEClient");
 if option arch = 00:00 {
   filename "default-i386/boot/grub/pxegrub2";
  } else if option arch = 00:07 {
   Filename "default-i386/boot/grub/grub2netx64.efi";
  }
}
```

Note: The subnet entry currently does not have an IP range configured.

5. Use the `installadm list` command to verify that your AI service is installed.

```
root@s11-server1:~# installadm list
Service Name Status Arch Type Secure Alias Aliases Clients Profiles Manifests
------------ ------ ---- ---- ------ ----  ------- ------- -------- ---------
basic_ai     on     i386 iso  no     no    1       0       0        1
default-i386 on     i386 iso  no     yes   0       0       0        1
```

6. Use the `installadm create-client` command to add the client MAC addresses for the S11-Client1 and S11-Client2 VMs to the `basic_ai` service. To obtain the MAC address:
   a. Traverse to the location of the `vm.cfg` files of the client VMs. These will be located under `/OVS/running_pool/<VM Name>/`.
   b. Open the `vm.cfg` file and make a note of the MAC address of the first network adapter. The following highlighted output illustrates this for the S11-Client1 VM.

```
# cat vm.cfg
VM_simple_name = 's11-client1'
vnclisten = '0.0.0.0'
serial = 'pty'
name = 's11-client1'
builder = 'hvm'
memory = 4096
boot = 'cdn'
disk = [ 'file:/OVS/running_pool/s11-client1/s11-
client1_disk1.img,xvda,w',
     ',xvdb:cdrom,r' ]
vif = [ 'mac=00:16:3e:00:01:06, bridge=virbr0',
        'mac=00:16:3e:00:02:06, bridge=virbr0' ]
vncunused = 1
uuid = ''
cpu_weight = 27500
cpu_cap = 0
vcpus = 1
maxvcpus = 4
vnc = 1
OVM_description = ''
on_poweroff = 'destroy'
on_reboot = 'restart'
on_crash = 'restart'
guest_os_type = 'default'
keymap = 'en-us'
OVM_os_type = 'Oracle Solaris 11'
OVM_domain_type = 'xen_hvm'
usb = 1
usbdevice = 'tablet'
```

c. Make a note of the MAC addresses. You will be using them frequently in this practice.

```
root@s11-server1:~# installadm create-client –e \
00:16:3E:00:01:06 -n basic_ai
Adding host entry for 00:16:3E:00:01:06 to local DHCP
configuration.
Created Client: '00:16:3E:00:01:06'
Restarting SMF service svc:/network/dhcp/server:ipv4
root@s11-server1:~# installadm create-client -e \
00:16:3E:00:01:07 -n basic_ai
Adding host entry for 00:16:3E:00:01:07 to local DHCP
configuration.
Created Client: '00:16:3E:00:01:07'
Restarting SMF service svc:/network/dhcp/server:ipv4
```

7. Use the `installadm list –c` command to verify that the client was added to the `basic_ai` AI server.

```
root@s11-server1:~# installadm list -c
Service Name Client Address    Arch  Secure Custom Args Custom Grub
------------ --------------    ----  ------ ----------- -----------
basic_ai     00:16:3E:00:01:06 i386  no     no          no
             00:16:3E:00:01:07 i386  no     no          no
```

8. Create a directory to store your manifest files.

```
root@s11-server1:~# mkdir –p /var/tmp/manifests
```

Note: Do not place manifest copies under the service directory that was created by the `installadm` utility. The service directory structure is private to `installadm` and must not be used for storage by users.

9. Copy the default manifest file to the `/var/tmp/manifests/basic_ai.xml` file.

```
root@s11-server1:~# cp \
/export/ai/basic_ai/auto_install/manifest/default.xml
/var/tmp/manifests/basic_ai.xml
```

10. Edit the `/var/tmp/manifests/basic_ai.xml` file XML tag elements by using the following:

- Change

```
<ai_instance name="default">
```

to

```
<ai_instance name="basic_ai" auto_reboot="true" >
```

- Change

```
 <origin name="http://pkg.oracle.com/solaris/release"/>
```

to

```
<origin name="http://s11-server1.example.com:10000"/>
```

- Change:

```
<name>pkg:/group/system/solaris-large-server</name>
```

to

```
<name>pkg:/group/system/solaris-small-server</name>
```

```
root@s11-server1:~# pfedit /var/tmp/manifests/basic_ai.xml
<?xml version="1.0" encoding="UTF-8"?>
<!--
 Copyright (c) 2008, 2014, Oracle and/or its affiliates. All rights
reserved.
-->
<!DOCTYPE auto_install SYSTEM "file:///usr/share/install/ai.dtd.1">
<auto_install>
  <ai_instance name="basic_ai" auto_reboot="true">
    <target>
      <logical>
        <zpool name="rpool" is_root="true">
        ...
        ...
        ...
          <filesystem name="export" mountpoint="/export"/>
          <filesystem name="export/home"/>
          <be name="solaris"/>
        </zpool>
      </logical>
    </target>
    <software type="IPS">
      <destination>
        <image>
          <!-- Specify locales to install -->
          <facet set="false">facet.locale.*</facet>
          <facet set="true">facet.locale.de</facet>
          <facet set="true">facet.locale.de_DE</facet>
          <facet set="true">facet.locale.en</facet>
          <facet set="true">facet.locale.en_US</facet>
          <facet set="true">facet.locale.es</facet>
          <facet set="true">facet.locale.es_ES</facet>
          <facet set="true">facet.locale.fr</facet>
          <facet set="true">facet.locale.fr_FR</facet>
          <facet set="true">facet.locale.it</facet>
          <facet set="true">facet.locale.it_IT</facet>
          <facet set="true">facet.locale.ja</facet>
          <facet set="true">facet.locale.ja_*</facet>
          <facet set="true">facet.locale.ko</facet>
          <facet set="true">facet.locale.ko_*</facet>
          <facet set="true">facet.locale.pt</facet>
```

```
          <facet set="true">facet.locale.pt_BR</facet>
          <facet set="true">facet.locale.zh</facet>
          <facet set="true">facet.locale.zh_CN</facet>
          <facet set="true">facet.locale.zh_TW</facet>
        </image>
      </destination>
      <source>
        ...
        ...
        ...
        <publisher name="solaris">
          <origin name="http://s11-server1.example.com:10000"/>
        </publisher>
      </source>
        ...
        ...
        ...
      <software_data action="install">
        <name>pkg:/entire@0.5.11-0.175.3</name>
        <name>pkg:/group/system/solaris-small-server</name>
      </software_data>
    </software>
  </ai_instance>
</auto_install>
```

11. Use the `diff` command to view the differences between the `basic_ai.xml` file and the `default.xml` file.

```
root@s11-server1:~# diff /var/tmp/manifests/basic_ai.xml \
/export/ai/basic_ai/auto_install/manifest/default.xml
9c9
<   <ai_instance name="basic_ai" auto_reboot="true">
---
>   <ai_instance name="default">
72c72
<           <origin name="http://s11-server1.example.com:10000"/>
---
>           <origin name="http://pkg.oracle.com/solaris/release"/>
90c90
<         <name>pkg:/group/system/solaris-small-server</name>
---
>         <name>pkg:/group/system/solaris-large-server</name>
```

12. Create a MAC address–based criteria manifest named `criteria_basic_ai.xml` in the `/var/tmp/manifests` directory. Use the MAC addresses of the network clients S11-Client1 and S11-Client2 in the same sequential order to avoid any error.

```
root@s11-server1:~# pfedit \
/var/tmp/manifests/criteria_basic_ai.xml
<ai_criteria_manifest>
    <ai_criteria name="mac">
      <range>
       00:16:3E:00:01:06
        00:16:3E:00:01:07
      </range>
    </ai_criteria>
</ai_criteria_manifest>
```

Note: If the AI client does not match the criteria for a service (in this case, a specific MAC address), then the AI service will use the default manifest when installing the OS.

13. Add the `basic_ai` manifest and criteria manifest to the `basic_ai` service.

```
root@s11-server1:~# installadm create-manifest –n basic_ai \
 -f /var/tmp/manifests/basic_ai.xml \
 -C /var/tmp/manifests/criteria_basic_ai.xml
Created Manifest: 'basic_ai'
```

When a custom AI manifest (`basic_ai.xml` in this example) is defined for this installation service and the client matches the criteria that have been specified (in the `criteria_basic_ai.xml` file) for the custom AI manifest, the client will use that manifest. In a case where the client characteristics match multiple AI manifests, the client characteristics are evaluated in the order of `mac`, `ipv4`, `platform`, `arch`, `cpu`, and `mem`.

If the client does not match the criteria for any custom AI manifest, the client uses the default AI manifest.

14. Use the `installadm list –m` command to verify that your manifests have been added to the `basic_ai` service.

```
root@s11-server1:~# installadm list -m
Service Name Manifest Name Type    Status  Criteria
------------ ------------- ----    ------  --------
basic_ai     basic_ai      xml     active  mac = 00:16:3E:00:01:06  - 00:16:3E:00:01:07
             orig_default  derived default none
default-i386 orig_default  derived default none
root@s11-server1:~# installadm list -m -n basic_ai
Service Name Manifest Name Type    Status   Criteria
------------ ------------- ----    ------   --------
basic_ai     basic_ai      xml     active   mac = 00:16:3E:00:01:06  - 00:16:3E:00:01:07
             orig_default  derived default  none
```

Practice 10-3: Deploying the OS to a Network Client

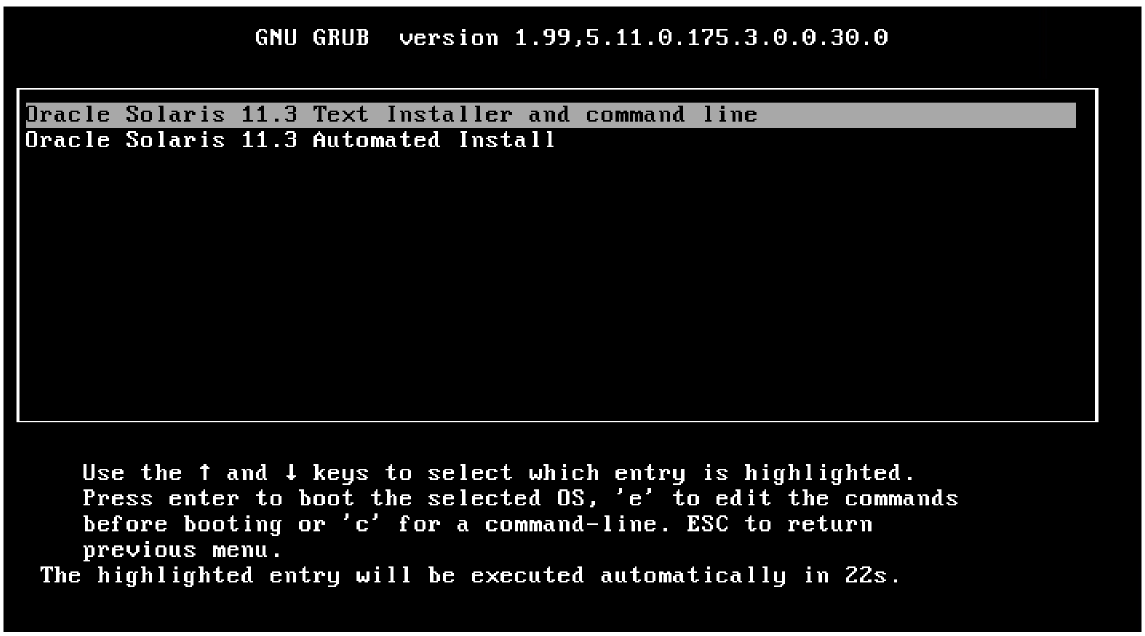
Overview

After you have completed AI server configuration, it is time to test your work by deploying the Oracle Solaris 11 operating system to a network client. In this practice, you perform a text installation over the network.

Task 1: Deploy the OS to a Network Client by Using Text Installer

To deploy the OS to a network client, perform the following steps:

1. Verify that the S11-Server1 VM is running and shut down the S11-Desktop VM.
2. Start the S11-Client1 VM. This will boot the S11-Client1 VM. If the AI server is configured correctly, you should see the OS installation begin.
3. When the S11-Client1 system starts the GNU GRUB menu, select the `Oracle Solaris 11.3 Text Installer and command line` boot option.



Notes

- When you choose the "default" boot option, the interactive system configuration menus you used during the "Text Install" practice will be available to you during this OS installation. Also, the IPS server is not used.
- The OS installation will take a while to complete.
- If the error "Could not obtain address of AI server from DHCP server" appears when starting the S11-Client1 VM, add the following entries to the `/etc/inet/dhcpd4.conf` file in the S11-Server1 VM:

```
host s11-client1 {
  hardware ethernet 00:16:3E:00:01:06;
   fixed-address 192.168.1.151;
}
host s11-client2 {
```

```
  hardware ethernet 00:16:3E:00:01:07;
   fixed-address 192.168.1.152;
}
host s11-client3 {
  hardware ethernet 00:16:3E:00:01:08;
   fixed-address 192.168.1.144;
}
host s11-client4 {
  hardware ethernet 00:16:3E:00:01:09;
   fixed-address 192.168.1.145;
}
```

After updating the file, run the following commands on S11-Server1, and restart the S11-Client1 VM.

```
# svcadm refresh /network/dhcp/server:ipv4
# svcadm refresh /system/install/server:default
```

4. During the OS installation process, use the configuration data that follows to complete the Text installation.

   Note: The Text installer program directs you to use the F2 or ESC + 2 keys to move to the next step in the installation process. If ESC + 2 does not work, try using the F2 key.

   - **Installation menu:** Install Oracle Solaris.
   - **Discovery Selection:** Local Disks
   - **Disks:** Default
   - **GPT Partitions:** Use the entire disk.
   - **Computer name:** s11-client1
   - **Network:** Automatically
   - **Time zone:** *Use your local region.*
   - **Locale: Language:** *Use your locale specific*
   - **Date and time:** *Set to current date and time.*
   - **Keyboard:** *Use your locale specific*
   - **Root password:** *oracle1*
   - **User account:**
     - **Your real name:** *oracle*
     - **Username:** *oracle*
     - **Password:** *oracle1*
     - **Confirm password:** *oracle1*
5. After the installation has completed, reboot (by pressing F8) the S11-Client1 VM.
6. After S11-Client1 completes the initial boot, log in as the *oracle* user and `su` to `root`.
7. Verify that the Sol11-Client1 virtual machine network configuration is set up correctly.

```
root@s11-client1:~# ipadm show-addr
ADDROBJ        TYPE     STATE        ADDR
lo0/v4         static   ok           127.0.0.1/8
net0/v4        dhcp     ok           192.168.1.151/24
lo0/v6         static   ok           ::1/128
net0/v6        addrconf ok           fe80::216:3eff:fe00:106/10
root@s11-client1:~# ping 192.168.1.100
192.168.1.100 is alive
```

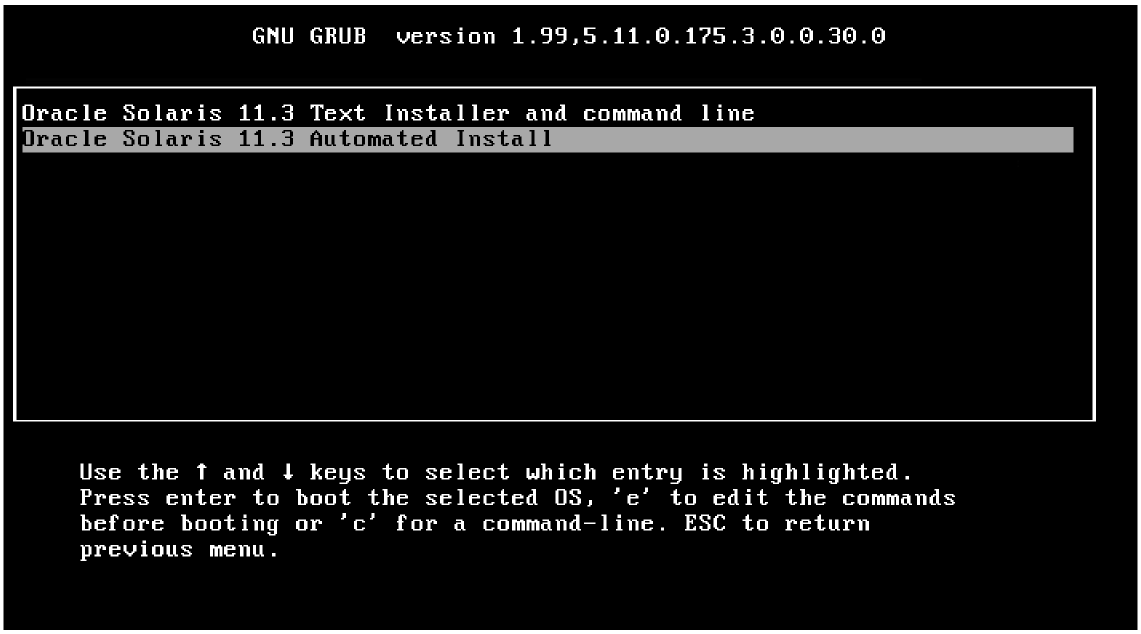
8. Shut down the S11-Client1 VM.

Task 2: Deploying the OS to a Network Client by Using IPS

In this task, you will perform OS installation over the network by using IPS.

To deploy the OS to a network client by using IPS, perform the following steps:

1. Verify that the S11-Server1 VM is running.
2. Start the S11-Client2 VM. If the AI server is configured correctly, you should see the OS installation begin.
3. When the S11-Client2 system starts the GNU GRUB menu, select the `Oracle Solaris 11.3 Automated Install` boot option.



Notes

- When you choose this boot option, the interactive system configuration is not available to you during this OS installation. IPS is used during the OS installation.
- The OS installation will take about 10-15 minutes to complete.
- The message traffic indicates that the IPS server is providing the installation packages.

4. After the installation has completed, reboot the S11-Client2 VM.
5. The SCI tool will be invoked during the OS startup. Enter the following system configuration information:

   Note: It may take some time to display the SCI tool.

   - **Computer name:** s11-client2
   - **Ethernet network configuration:** Automatically
   - **Time zone: Regions:** *Use your local region.*
   - **Time zone: Locations:** *Use your local region.*
   - **Time Zone:** *Use your local region specific.*
   - **Locale: Language:** *Use your local region specific.*
   - **Locale: Territory:** *Use your local region specific.*
   - **Date and time:** *Set to current date and time.*

- **Keyboard:** *Use your local region specific.*
- **Root password:** *`oracle1`*
- **User account:**
  - **Your real name:** *`oracle`*
  - **Username:** *`oracle`*
  - **Password:** *`oracle1`*
  - **Confirm password:** *`oracle1`*
- **Support registration:** Default options
- **Support: Network Configuration:** Default (no proxy)

6. After S11-Client2 completes the initial boot, log in as the `oracle` user and `su` to root.
7. Verify that the Sol11-Client2 virtual machine network configuration is set up correctly.

```
root@s11-client2:~# ipadm show-addr
ADDROBJ         TYPE      STATE        ADDR
lo0/v4          static    ok           127.0.0.1/8
net0/v4         dhcp      ok           192.168.1.152/24
lo0/v6          static    ok           ::1/128
net0/v6         addrconf  ok           fe80::a00:27ff:fe33:dc4c/10
root@s11-client2:~# ping 192.168.1.100
192.168.1.100 is alive
```

8. Shut down the S11-Client2 VM.

Practice 10-4: Configuring Oracle Solaris 11 Instances

Overview

After the Oracle Solaris 11 operating system is installed, the instance must be configured with attributes such as host name, IP address, naming services, and user credentials. The `sysconfig` utility is the interface for configuring, reconfiguring, and unconfiguring the Oracle Solaris instance. A Solaris instance is defined as a boot environment in either a global or a nonglobal zone.

There are three operations that are performed using the `sysconfig` utility:

- Unconfiguration
- Configuration
- System configuration (SC) profile creation

In this practice, you will perform the following tasks:

- Unconfigure an Oracle Solaris 11 instance.
- Configure the Oracle Solaris 11 instance using a SC profile.
- Set the host name, time zone, and naming service.

Task 1: Unconfiguring an Oracle Solaris 11 Image

To unconfigure a configured Oracle Solaris 11 image, perform the following steps:

1. Verify that the S11-Server1 VM is running.
   If not, start it now by using the user ID *`oracle`* and password *`oracle1`*. Then, assume the `root` role by using password *`oracle1`*.
2. Start the S11-Client1 VM.
3. Determine the current host name and IP address.

```
root@s11-client1:~# hostname
s11-client1
root@s11-client1:~# ipadm show-addr
ADDROBJ          TYPE      STATE         ADDR
lo0/v4           static    ok            127.0.0.1/8
net0/v4          dhcp      ok            192.168.1.151/24
lo0/v6           static    ok            ::1/128
net0/v6          addrconf  ok            fe80::216:3eff:fe00:106/10
```

Note: The default network interface is `net0`.

4. Use the `sysconfig` utility to return Oracle Solaris 11 to an unconfigured (pristine) state.
   Note: After running the `sysconfig` command, wait for a few minutes for the prompt to return.

```
root@s11-client1:~# sysconfig unconfigure
This program will unconfigure your system.
Do you want to continue (yes/[no])? yes
...
...
```

```
...
Do you want to continue (yes/[no])? yes
Please wait while services are unconfigured. This may take a few
moments...

root@s11-client1:~# <Press Enter Key>

Enter user name for system maintenance (control-d to bypass): root
Enter root password (control-d to bypass): solaris
single-user privilege assigned to root on /dev/console.
Entering System Maintenance Mode.
...
root@s11-client1:~#
```

5. Determine the current host name and IP address.

```
root@s11-client1:~# hostname
s11-client1
root@s11-client1:~# ipadm show-addr
ADDROBJ           TYPE     STATE      ADDR
lo0/v4            static   ok         127.0.0.1/8
lo0/v6            static   ok         ::1/128
net0/v4           dhcp     disabled   ?
net0/v6           addrconf disabled   ::
```

6. Determine if the default user account `oracle` still exists.

```
root@s11-client1:~# logins | grep oracle
root@s11-client1:~#
```

At this point, you have a pristine system. The next time the system is booted, the System Configuration Tool will be run. The System Configuration Tool helps you establish a new system configuration.

7. Reboot the system.

```
root@s11-client1:~# init 6
...
```

8. When the System Configuration Tool is available, use the following properties to configure the system:
   - **Host name:** `s11-client1`
   - **Network:** `Manually`
   - **Manually Configure:** net0/v4: `192.168.1.140`
   - **DNS Name Service:** `Configure DNS`
   - **DNS Server Addresses:** `192.168.1.100`
   - **DNS Search List:** `example.com`
   - **Alternate Name Service:** `None`
   - **Time Zone: Regions:** *Your local time zone*

- **Time Zone:** Locations: *Your location specific*
- **Time Zone:** *Use default value.*
- **Locale: Language:** *Your locale specific*
- **Keyboard:** *Your region specific*
- **Root password:** *oracle1*
- **Your real name:** *oracle*
- **Username:** *oracle*
- **User password:** *oracle1*
- **Confirm password:** *oracle1*

```
SC profile successfully generated.
/etc/svc/profile/sysconfig/sysconfig-20140305-
041311/sc_profile.xml
Exiting System Configuration Tool. Log is available at:
/var/tmp/install/sysconfig/sysconfig.log.209
Hostname: s11-client1

s11-client1 console login:
```

9. Log in to S11-Client1 as user `oracle` and assume the `root` role.
10. Determine the current host name and IP address.

```
root@s11-client1:~# hostname
s11-client1
root@s11-client1:~# ipadm show-addr
ADDROBJ           TYPE     STATE     ADDR
lo0/v4            static   ok        127.0.0.1/8
net0/v4           static   ok        192.168.1.140/24
lo0/v6            static   ok        ::1/128
net0/v6           addrconf ok        fe80::a00:27ff:fe3e:b6e9/10
```

Task 2: Configuring the Oracle Solaris 11 Image by Using a System Configuration Profile

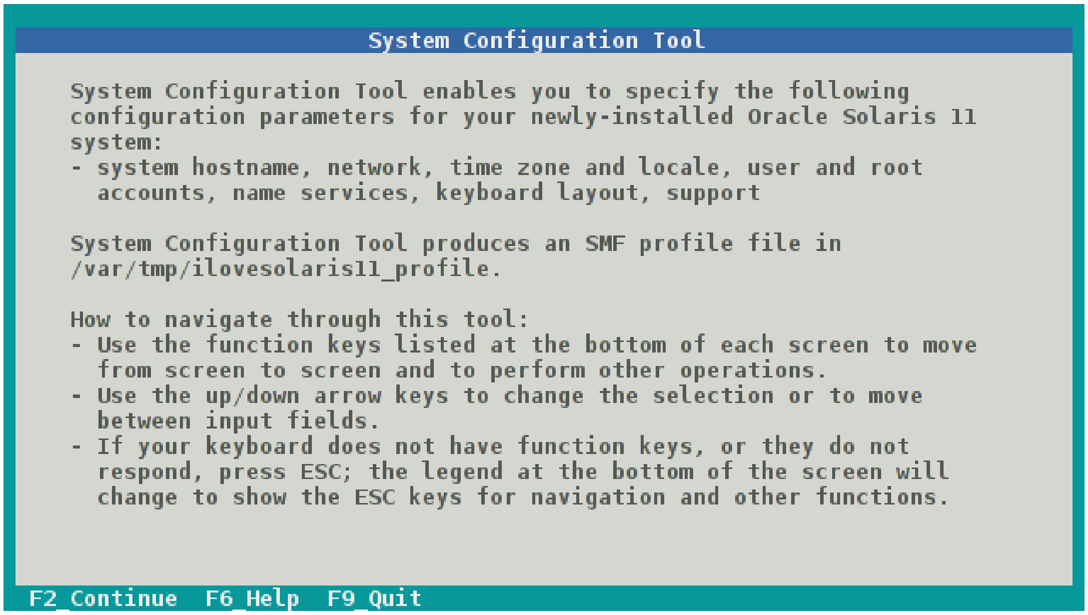
The `sysconfig` utility can be used to generate a system configuration (SC) profile by using the `create-profile` subcommand. The resulting XML profile can later be used with the `sysconfig configure` command to configure systems noninteractively. Valid SC profile names must include the `.xml` extension.

To configure the Oracle Solaris 11 image using an SC profile, perform the following steps:

1. On the S11-Client1 VM, create an SC profile by using the following system configuration attributes:

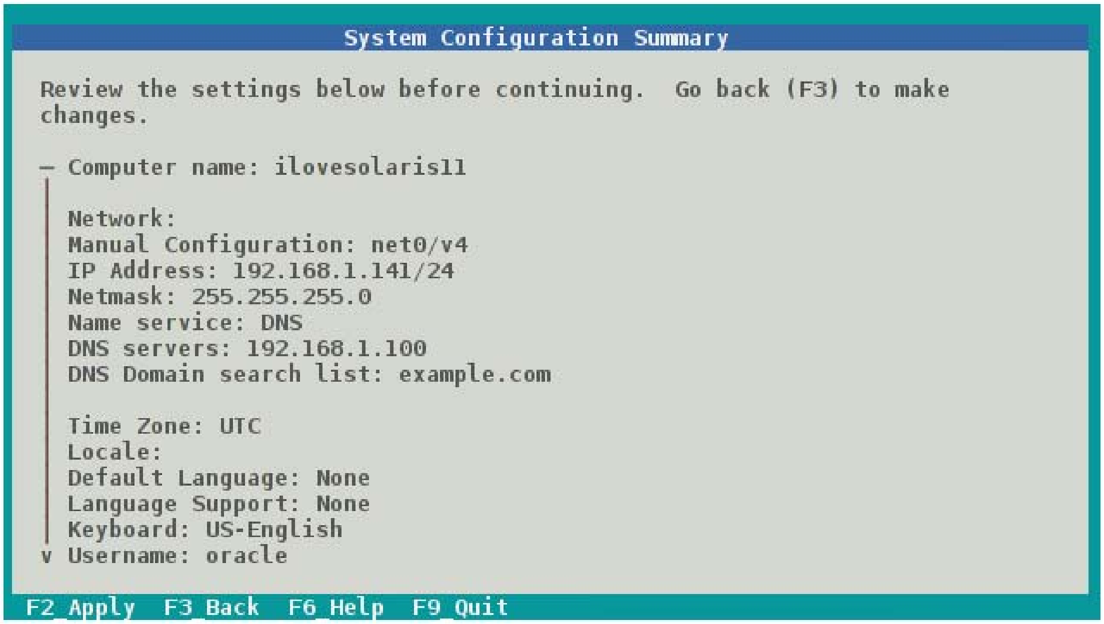
```
root@s11-client1:~# sysconfig create-profile \
-o /var/tmp/ilovesolaris11_profile
```

Note: The `sysconfig create-profile` utility launches the SCI tool.



Use the following system configuration attributes while creating the SC profile:

- **Host name:** `ilovesolaris11`
- **Network:** Manually
- **Manually Configure:** net0/v4: `192.168.1.141`
- **DNS Name Service:** Configure DNS
- **DNS Server Addresses:** `192.168.1.100`
- **DNS Search List:** `example.com`
- Alternate name service: None
- **Time Zone:** Regions: *Your local time zone*
- **Time Zone:** Locations: *Your location specific*
- **Time Zone:** *Use default value*
- **Locale:** Language: *Your locale specific*
- **Keyboard:** *Your region specific*
- **Root password:** *`oracle2`*
- **Confirm password:** *`oracle2`*
- **Your real name:** *`oracle2`*
- **User login:** *`oracle2`*
- **User password:** *`oracle2`*
- **Confirm password:** *`oracle2`*



2. Explore the newly created SC profile.

```
root@s11-client1:~# cd /var/tmp/ilovesolaris11_profile
root@s11-client1:/var/tmp/ilovesolaris11_profile# more
sc_profile.xml
<?xml version='1.0' encoding='US-ASCII'?>
<!DOCTYPE service_bundle SYSTEM
"/usr/share/lib/xml/dtd/service_bundle.dtd.1">
<service_bundle type="profile" name="sysconfig">
  <service version="1" type="service" name="system/identity">
...
...
root@s11-client1:/var/tmp#
```

3. Use the `ilovesolaris11_profile/sc_profile.xml` profile to reconfigure the system.

   Note: After running the `sysconfig` command, wait for a few minutes for the prompt to return.

```
root@s11-client1:/var/tmp/ilovesolaris11_profile# sysconfig
configure -c /var/tmp/ilovesolaris11_profile/sc_profile.xml
This program will re-configure your system.
Do you want to continue (yes/[no])? yes
Please wait while services are configured. This may take a few
moments...
root@s11-client1:/var/tmp/ilovesolaris11_profile#
ilovesolaris11 console login:
```

4. Log in to the system as the `oracle2` user with the password `oracle2` and `su` to `root` with the password `oracle2`.

Task 3: Setting the Host Name, Time Zone, and Naming Service

The primary repository for all naming services configuration is the SMF repository. You can use the SMF utilities, such as `svccfg`, `svcprop`, and `svcadm`, to set and modify any configuration parameter for the host name and a naming service.

To reconfigure the host name, time zone, and naming service, perform the following steps:

1. On the S11-Client1 VM, change the host name to client5.

```
root@ilovesolaris11:~# svccfg -s svc:/system/identity:node \
setprop config/nodename=client5
root@ilovesolaris11:~# svcadm refresh svc:/system/identity:node
root@ilovesolaris11:~# Hostname:client5
Oct 1 10:33:12 ilovesolaris11 rpcbind: rpcbind terminating on
signal.

Note: Press the Enter key if the prompt doesn't return. Hostname:client5

root@ilovesolaris11:~# svcadm restart identity:node
root@ilovesolaris11:~# Hostname:client5

Note: Press the Enter key if the prompt doesn't return. Hostname:client5

root@ilovesolaris11:~# exit
logout
oracle@ilovesolaris11:~$ exit
logout

client5 console login: oracle2
Password: oracle2
oracle2@client5:~$ su -
Password: oracle2
root@client5:~#
```

2. On the Sol11-Client1 virtual machine, change the time zone to US/Central.

```
root@client5:~# svccfg -s timezone:default \
setprop timezone/localtime=US/Central
root@client5:~# svcadm refresh timezone:default
root@client5:~# date
Wed Nov 1 04:47:12 CST 2016
```

3. On the S11-Client1 VM, configure the DNS naming service using these properties.
   - DNS server address: `192.168.1.100`
   - DNS search: `example.com`

```
root@client5:~# svccfg
svc:> select dns/client
svc:/network/dns/client> setprop config/search=example.com
```

```
svc:/network/dns/client> setprop config/nameserver=192.168.1.100
svc:/network/dns/client> select dns/client:default
svc:/network/dns/client:default> validate
Property has bad type:
    ...
(output truncated)
svc:/network/dns/client:default> refresh
svc:/network/dns/client:default> select name-service/switch
svc:/system/name-service/switch> setprop config/host="files dns"
svc:/system/name-service/switch> select system/name-
service/switch:default
svc:/system/name-service/switch:default> refresh
svc:/system/name-service/switch:default> validate
svc:/system/name-service/switch:default> exit
root@client5:~# svcadm enable dns/client
root@client5:~# svcadm refresh name-service/switch
root@client5:~# grep host /etc/nsswitch.conf
hosts: files dns
root@client5:~# tail -4 /etc/resolv.conf
# See resolv.conf(4) for details.

search  example.com
nameserver      192.168.1.100
```

4. Power off the S11-Client1 VM.

Practice 10-5: Customizing the Automated Installation

Overview

Automatic Installation enables you to customize your Oracle Solaris 11 installations by adding system configuration (SC) profiles. SC profiles are used to customize the system attributes such as host name, IP address, naming services, and user credentials of the AI clients.

- Perform all steps carefully. Any syntax error made while configuring the AI server may lead to unsuccessful installation of clients.

Task 1: Customizing an AI Service

Now that you have AI working, you are ready to customize the AI service. In this task, you configure the AI server to automatically install an Oracle Solaris 11 desktop client by using the AI custom system configuration profile.

To customize the AI service, perform the following steps on S11-Server1 VM:

1. Disable the `basic_ai` AI service and show the results.

```
root@s11-server1:~# installadm set-service –D -n basic_ai
Changed Server Status Service: 'basic_ai'
Refreshing SMF service svc:/system/install/server:default
root@s11-server1:~# installadm list
Service Name Status Arch Type Secure Alias Aliases Clients Profiles Manifests
------------ ---- ---- --- ---- ---- ------ ----- ------- -------
basic_ai     off    i386 iso  no     no    1       2       0        2
default-i386 on     i386 iso  no     yes   0       0       0        1
```

2. Remove the `basic_ai` AI service and show the results.

```
root@s11-server1:~# installadm delete-service -r basic_ai
WARNING: The service you are deleting, or a dependent alias, is the
alias for the default i386 service. Without the 'default-i386'
service, i386 clients will fail to boot unless explicitly assigned to
a service using the create-client subcommand.
Are you sure you want to delete this alias? [y|N]: y
Removing this service's bootfile(s) from local DHCP configuration
Deleted Service: 'default-i386'
Removing host entry '00:16:3E:00:01:07' from local DHCP configuration.
Removing host entry '00:16:3E:00:01:06' from local DHCP configuration.
Warning: mDNS registry of service basic_ai could not be verified.
Refreshing SMF service svc:/system/install/server:default
Refreshing SMF service svc:/network/dhcp/server:ipv4
root@s11-server1:~# installadm list
There are no services configured on this server.
```

3. Create a directory for the custom AI service.

```
root@s11-server1:~# mkdir –p /export/ai/custom_ai
```

4. Use the `installadm create-service` command to create another AI service based on the following information:
   - Service name: `custom_ai`
   - AI ISO image location: `/opt/ora/iso/sol-11_3-ai-x86.iso`
   - Target directory: `/export/ai/custom_ai`

```
root@s11-server1:~# installadm create-service -n custom_ai \
-s /opt/ora/iso/sol-11_3-ai-x86.iso -d /export/ai/custom_ai
  0% : Creating service from /opt/ora/iso/sol-11_3-ai-x86.iso
 34% : Transferring contents
 34% : Creating i386 service: custom_ai
 34% : Image path: /export/ai/custom_ai
 34% : Setting "solaris" publisher URL in default manifest to:
 34% : http://s11-server1.example.com:10000/
...
...
100% : Created Service: 'custom_ai'
100% : Refreshing SMF service svc:/system/install/server:default
100% : Restarting SMF service svc:/network/dhcp/server:ipv4
100% : Service 'custom_ai' has been added to the mDNS registry
100% : Service 'default_ai' has been added to the mDNS registry
```

5. Use the `installadm list` command to verify that your AI service is installed.

```
root@s11-server1:~# installadm list
Service Name Status Arch Type Secure Alias Aliases Clients Profiles Manifests
------------ ------ ---- --- ------ ----- ------- ------- -------- ---------
custom_ai     on    i386 iso no     no    1       0       0        1
default-i386  on    i386 iso no     yes   0       0       0        1
```

6. Use the `installadm create-client` command to add the MAC address of S11-Client3 VM to the `custom_ai` service.

```
root@s11-server1:~# installadm create-client -e 00:16:3E:00:01:08 -n
custom_ai
Adding host entry for 00:16:3E:00:01:08 to local DHCP configuration.
Created Client: '00:16:3E:00:01:08'
Restarting SMF service svc:/network/dhcp/server:ipv4
```

7. Use the `installadm list -c` command to verify that the client was added to AI server `custom_ai`.

```
root@s11-server1:~# installadm list -c
Service Name Client Address    Arch  Secure Custom Args Custom Grub
------------ -------------    ----  ------ ----------- -----------
custom_ai    00:16:3E:00:01:08 i386  no     no          no
```

8. Copy the `/var/tmp/manifests/basic_ai.xml` file to the `/var/tmp/manifests/custom_ai.xml` file.

```
root@s11-server1:~# cp /var/tmp/manifests/basic_ai.xml \
/var/tmp/manifests/custom_ai.xml
```

9. Modify the `/var/tmp/manifests/custom_ai.xml` file XML tag elements such that it reflects the following details:
   - AI instance name (`ai_instance name`): `custom_ai`
10. Use the `diff` command to view the differences between the `custom_ai.xml` file and the `basic_ai.xml` file.

```
root@s11-server1:~# diff /var/tmp/manifests/custom_ai.xml \
/var/tmp/manifests/basic_ai.xml
9c9
<    <ai_instance name="custom_ai" auto_reboot="true">
---
>    <ai_instance name="basic_ai" auto_reboot="true">
```

11. Create a MAC address–based criteria manifest named `criteria_custom_ai.xml` in the `/var/tmp/manifests` directory. Use the MAC address of the network client S11-Client3.

```
root@s11-server1:~# pfedit \
/var/tmp/manifests/criteria_custom_ai.xml
<ai_criteria_manifest>
    <ai_criteria name="mac">
      <value>
    00:16:3E:00:01:08
      </value>
    </ai_criteria>
</ai_criteria_manifest>
```

Note: If the AI client does not match the criteria for a service (in this case, a specific MAC address), the AI service will use the default manifest when installing the OS.

12. Add the `custom_ai` manifest and criteria manifest to the `custom_ai` service and show the results.

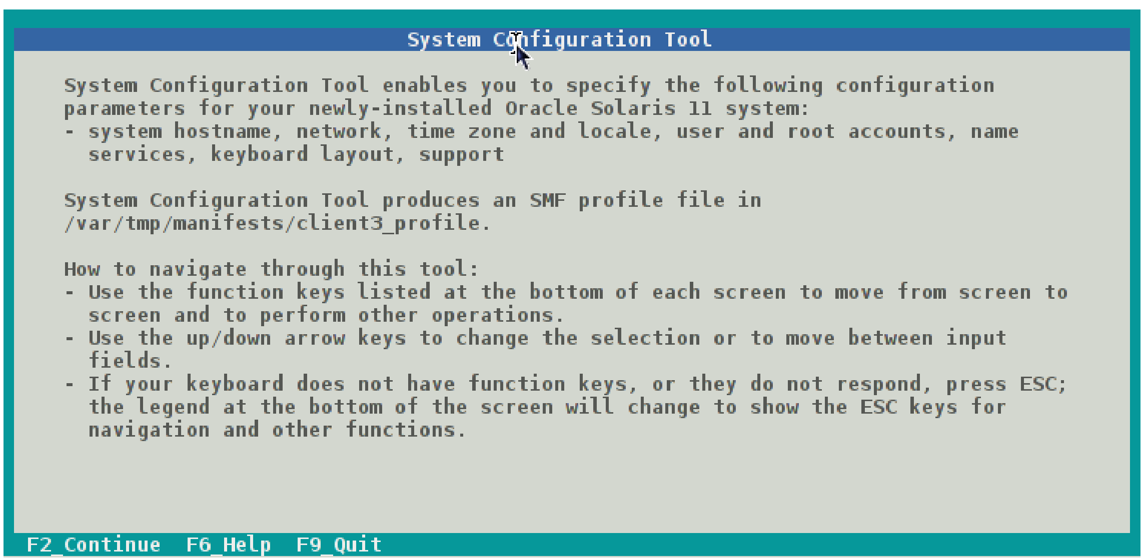
```
root@s11-server1:~# installadm create-manifest –n custom_ai \
-f /var/tmp/manifests/custom_ai.xml \
–C /var/tmp/manifests/criteria_custom_ai.xml
Created Manifest: 'custom_ai'
root@s11-server1:~# installadm list -c -m
Service Name Client Address    Arch  Secure Custom Args Custom Grub
------------ -------------     ----  ------ ----------- -----------
custom_ai    00:16:3E:00:01:08 i386  no     no          no
sService Name Manifest Name Type    Status  Criteria
------------ -----------  ----    ------  --------
custom_ai    custom_ai       xml     active  mac = 00:16:3E:00:01:08
             orig_default    derived default none
default-i386 orig_default    derived default none
```

13. Use the `sysconfig` utility to create a profile for S11-Client3 using the following properties:
   - Host name: `s11-client3`
   - Network: `Manually`

- Manual Network Configuration: `net0 (e1000g0)`
- Manually Configure: net0/v4: ~~192.168.0.142~~ `192.168.1.153`
- DNS Name Service: `Configure DNS`
- DNS Server Addresses: `192.168.1.100`
- DNS Search List: `example.com`
- Alternate name service: `None`
- Time Zone: Regions: *Your local time zone*
- Time Zone: Locations: *Your local time zone*
- Locale: Language: *Your locale specific*
- Locale: Territory: *Your locale specific*
- Keyboard: *Your region specific*
- Root password: `oracle1`
- Your real name: `oracle1`
- Username: `oracle`
- User password: `oracle1`
- Support Registration: Default
- Support: Network Configuration: Default

```
root@s11-server1:~# sysconfig create-profile \
-o /var/tmp/manifests/client3_profile
```

Note: The `sysconfig create-profile` utility launches a system configuration tool.



The System Configuration Summary should look similar to the following:

```
                         System Configuration Summary

 Review the settings below before continuing.  Go back (F3) to make changes.

 - Computer name: s11-client3
 |
 | Network:
 | Manual Configuration: net0/v4
 | IP Address: 192.168.1.153/24
 | Netmask: 255.255.255.0
 | Name service: DNS
 | DNS servers: 192.168.1.100
 | DNS Domain search list: example.com
 |
 | Time Zone: UTC
 | Locale:
 | Default Language: English
 | Language Support: English (United States)
 | Keyboard: US-English
 | Username: oracle
 v
 F2_Apply  F3_Back  F6_Help  F9_Quit
```

14. View the contents of the Sol11-Client3 profile.

```
root@s11-server1:~# more \
/var/tmp/manifests/client3_profile/sc_profile.xml
<?xml version='1.0' encoding='UTF-8'?>
<!DOCTYPE service_bundle SYSTEM
"/usr/share/lib/xml/dtd/service_bundle.dtd.1">
<service_bundle type="profile" name="sysconfig">
  <service version="1" type="service" name="system/identify">
    <instance enabled="true" name="node">
...
...
(output truncated)
```

15. Add the system configuration profile manifest `custom_ai` service and show the results.

```
root@s11-server1:~# installadm create-profile -n custom_ai \
-f /var/tmp/manifests/client3_profile/sc_profile.xml \
-p client3_profile \
-C /var/tmp/manifests/criteria_custom_ai.xml
Created Profile: 'client3_profile'
root@s11-server1:~# installadm list -p -n custom_ai
Service Name Profile Name     Criteria
------------ ------------     --------
custom_ai    client3_profile  mac  = 00:16:3E:00:01:08
```

16. Validate the system configuration profile.

```
root@s11-server1:~# installadm validate -n custom_ai \
-p client3_profile
Validating static profile client3_profile...
   Passed
```

```
root@s11-server1:~#
```

Task 2: Deploying the OS to a Network Client

After you have completed AI server configuration, it is time to test your work by deploying the Oracle Solaris 11 operating system to a network client.

To deploy the OS to a network client, perform the following steps:

1. Verify that the S11-Server1 VM is running.
2. Start the S11-Client3 VM. If the AI server is configured correctly, you should see the OS installation begin in the VM.

   Note: Perform the next step as soon as possible.
3. When the S11-Client3 system starts the GNU GRUB menu, select the `Oracle Solaris 11.3 Automated Install` boot option.

   Notes
   - When you choose this boot option, the interactive system configuration is not available to you during this OS installation. IPS is used during the OS installation.
   - The message traffic indicates that the IPS server is providing the installation package.
   - The installation takes some time to complete.
4. After the OS installation is complete, reboot from the hard disk and log in as `oracle`. Check the system configuration to verify that the OS is configured according to the profile.

   Note: Change the boot order from '`ncd`' to `cdn`' after installation and before reboot.
5. Shut down and power off the Sol11-Client3 VM.

Practice 10-6: (Optional) Deploying a System by Using a Unified Archive Through Automated Installer

Overview

You can use AI to deploy a system by using Unified Archives. After an archive is created, you can store the archive as a file until it is needed. Deployment scenarios include system recovery and system migration, as well as system cloning.

Notes

- Ensure that you successfully completed Practice 10-5 before proceeding with the current practice.
- Perform all steps carefully. Any syntax error made while configuring the AI server may lead to unsuccessful installation of clients.
- Creating a Unified Archive takes about 20-25 minutes. Therefore, for this training, a Unified Archive has already been created for you by performing the following steps. The archive file can be found in the `/opt/ora` directory of the host machine:

```
# archiveadm create -r /opt/ora/labs/ra-allzones.uar
Initializing Unified Archive creation resources...
Unified Archive initialized: /opt/ora/labs/ra-allzones.uar
Logging to: /system/volatile/archive_log.12516
Executing dataset discovery...
Dataset discovery complete
Creating install media for zone(s)...
Media creation complete
Preparing archive system image...
Beginning archive stream creation...
Archive stream creation complete
Beginning final archive assembly...
Archive creation complete
```

Task 1: Copying the Oracle Solaris Unified Archive File

In this task, you copy the archive to the AI server's web directory for universal access:

1. View the recovery archive information:

```
root@s11-server1:~# archiveadm info /opt/ora/labs/ra-
allzones.uar
Archive Information
          Creation Time:  2015-09-04T14:58:35Z
            Source Host:  s11-client2
           Architecture:  i386
       Operating System:  Oracle Solaris 11.3 X86
     Deployable Systems: global

root@s11-server1:~# archiveadm info -v /opt/ora/labs/ra-
allzones.uar
Archive Information
```

```
         Creation Time:  2015-09-04T14:58:35Z
           Source Host:  s11-client2
          Architecture:  i386
      Operating System:  Oracle Solaris 11.3 X86
      Recovery Archive:  Yes
             Unique ID:  5d98c083-5275-4da1-991c-ccafacc2668d
       Archive Version:  1.0

Deployable Systems
          'global'
            OS Version:  0.5.11
             OS Branch:  0.175.3.0.0.30.0
             Active BE:  solaris
                 Brand:  solaris
                 Zones:  zone11,zone12
           Size Needed:  7.4GB
             Unique ID:  3d9a9381-7aeb-49c7-b230-f669d475295f
              AI Media:  0.175.3_ai_i386.iso
             Root-only:  Yes
```

In the output, observe that the `ra-allzones.uar` archive contains a global zone and two nonglobal zones.

2. Copy the `ra-allzones.uar` recovery archive file to the AI server, such that it could be accessed from the target host during the Automated Installation process:

```
root@s11-server1:~# mkdir -p /var/ai/image-server/images/archives

root@s11-server1:~# svccfg -s install/server:default setprop \
all_services/webserver_files_dir = archives

root@s11-server1:~# svcadm refresh install/server:default
root@s11-server1:~# cp /opt/ora/labs/ra-allzones.uar /var/ai/image-
server/images/archives/
```

Note: The `cp` command will take few minutes to copy the recovery archive to the AI server.

3. On the S11-Desktop VM, verify the access to the recovery archive from a browser by using the following URL:

```
http://s11-server1.example.com:5555/archives/
or
http://192.168.1.100:5555/archives/
```

Task 2: Configuring an AI Manifest for the Client

In this task, you configure the AI server to automatically install an Oracle Solaris 11 client by using the AI custom system configuration profile.

To customize the AI service, perform the following steps on the S11-Server1 VM:

1. Use the `installadm list` command to verify that your AI service is installed.

```
root@s11-server1:~# installadm list
Service Name Status Arch Type Secure Alias Aliases Clients Profiles Manifests
------------ ------ ---- ---- ------ ----- ------- ------- -------- ---------
custom_ai    on     i386 iso  no     no    1       1       1        2
default-i386 on     i386 iso  no     yes   0       0       0        1
```

2. Use the `installadm create-client` command to add the MAC address of S11-Client4 VM to the `custom_ai` service.

```
root@s11-server1:~# installadm create-client -e \
00:16:3e:00:01:09 -n custom_ai
Adding host entry for 00:16:3e:00:01:09 to local DHCP
configuration.
Created Client: '00:16:3e:00:01:09'
Restarting SMF service svc:/network/dhcp/server:ipv4
```

3. Use the `installadm list –c` command to verify that the client was added to AI server `custom_ai`.

```
root@s11-server1:~# installadm list -c
Service Name Client Address    Arch Secure Custom Args Custom Grub
------------ -------------     ---- ------ ----------- -----------
custom_ai    00:16:3e:00:01:08 i386 no     no          no
             00:16:3e:00:01:09 i386 no     no          no
```

4. Copy the default archive manifest file to the `/var/tmp/manifests/archive_ai.xml` file to create a custom manifest file for using the unified archive file.

```
root@s11-server1:~# cp
/export/ai/custom_ai/auto_install/manifest/default_archive.xml \
/var/tmp/manifests/archive_ai.xml
```

5. Modify the XML tag elements of the `/var/tmp/manifests/archive_ai.xml` file such that it reflects the following details:
   - AI instance name (`ai_instance name`): **`custom_ai`**
   - Archive File URI (`file uri`): `http://s11-server1.example.com:5555/archives/ra-allzones.uar`.

6. Edit the contents of the `/var/tmp/manifests/archive_ai.xml` manifest file:

```
root@s11-server1:~# pfedit /var/tmp/manifests/archive_ai.xml
<?xml version="1.0" encoding="UTF-8"?>
<!--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reserved.
```

```
-->
<!--
  Default manifest for the Automated Installer to install from a
Solaris Unified
  Archive located on the recovery media.
-->
<!DOCTYPE auto_install SYSTEM
"file:///usr/share/install/ai.dtd.1">
<auto_install>
  <ai_instance name="custom_ai">
    <target>
      <logical>
        <zpool name="rpool" is_root="true">
          <!--
            Subsequent <filesystem> entries instruct an
installer to create
            the following ZFS datasets:

                <root_pool>/export         (mounted on /export)
                <root_pool>/export/home    (mounted on
/export/home)

            Those datasets are part of the standard environment
and should
            always be created.

            Those datasets, and others, will often be included
in the content
            of the unified archive and will be created
automatically upon
            installation from the unified archive. In such
cases, the archive
            overrides any <filesystem>, <be> or <zvol> entries
that conflict
            with the archive contents. These conflicts are
reported in the
            installation log file.
          -->
          <filesystem name="export" mountpoint="/export"/>
          <filesystem name="export/home"/>
        </zpool>
      </logical>
    </target>
    <software type="ARCHIVE">
```

```
        <source>
          <!--
            Specify the location of the archive via file path or
HTTP/HTTPS URL.

            <file uri="/tmp/myarchive.uar"/>
            <file uri="/net/someserver/dir/myarchive.uar"/>
            <file uri="http://someserver/dir/myarchive.uar"/>
            <file uri="https://someserver/dir/myarchive.uar">
              <credentials>
                <key src="http://someserver/creds/mykey.pem"/>
                <cert src="http://someserver/creds/mycert.pem"/>
                <ca_cert
src="http://someserver/creds/myca_cert.pem"/>
              </credentials>
            </file>

            The default setting supports archive deployment via
recovery media.
            Bootable recovery media is pre-configured to include
the archive at file:///.cdrom/archive.uar and to install the
system from that archive.
     -->
          <file uri="http://s11-
server1.example.com:5555/archives/ra-allzones.uar"/>
        </source>
        <software_data action="install">
          <!--
            Specify the name of the system from within the archive
by its
            zonename. The '*' is used as shorthand for "all
systems" with
            recovery archives as well as single-system clone
archives.
          -->
          <name>global</name>
        </software_data>
      </software>
    </ai_instance>
</auto_install>

:wq
```

7. Use the `diff` command to view the differences between the `archive_ai.xml` file and the `default_archive.xml` file.

```
root@s11-server1:~# diff /var/tmp/manifests/archive_ai.xml \
/export/ai/custom_ai/auto_install/manifest/default_archive.xml
13c13
<    <ai_instance name="custom_ai">
---
>    <ai_instance name="default">
60c60
<          <file uri="http://s11-
server1.example.com:5555/archives/ra-allzones.uar>
---
>          <file uri="file:///.cdrom/archive.uar"/>
```

8. Create a MAC address–based criteria manifest file `criteria_archive_ai.xml` in the `/var/tmp/manifests` directory by using the MAC address of the network client Sol11-Client4.

```
root@s11-server1:~# pfedit \
/var/tmp/manifests/criteria_archive_ai.xml
<ai_criteria_manifest>
    <ai_criteria name="mac">
      <value>
       00:16:3E:00:01:09
      </value>
    </ai_criteria>
</ai_criteria_manifest>
```

Note: If the AI client does not match the criteria for a service (in this case, a specific MAC address), then the AI service will use the default manifest when installing the OS.

9. Add the `archive_ai` manifest and criteria manifest to the `custom_ai` service and view the result.

```
root@s11-server1:~# installadm create-manifest -m archive_ai -n \
custom_ai -f /var/tmp/manifests/archive_ai.xml       \
-C /var/tmp/manifests/criteria_archive_ai.xml
Created Manifest: 'archive_ai'

root@s11-server1:~# installadm list -c -m
Service Name Client Address    Arch Secure Custom Args Custom Grub
------------ --------------    ---- ------ ----------- -----------
custom_ai    00:16:3e:00:01:08 i386 no     no          no
             00:16:3e:00:01:09 i386 no     no          no
Service Name Manifest Name Type    Status  Criteria
------------ ------------- ----    ------  --------
custom_ai    archive_ai    xml     active  mac = 00:16:3e:00:01:09
             custom_ai     xml     active  mac = 00:16:3e:00:01:08
             orig_default  derived default none
default-i386 orig_default  derived default none
```

10. Use the `sysconfig` utility to create a system configuration profile for S11-Client4.

```
root@s11-server1:~# sysconfig create-profile          \
-o /var/tmp/manifests/client4_profile
```

Use the following properties when creating a profile for Sol11-Client4:

- **Host name:** `s11-client4`
- **Network configuration:** `Manually`
  - **Network Interface:** `net0 (e1000g0)`
  - **IP Address:** `192.168.1.145`
  - **Configure DNS:** `Yes`
  - **DNS Server IP address:** `192.168.1.100`
  - **Search domain:** `example.com`
  - **Alternate Name Service:** None
- **Time zone:** *Use your local region.*
- **Language:** *Use your local language.*
- **Local: Territory:** *Use your local territory.*
- **Keyboard:** *Use your local keyboard.*
- **Root password:** `oracle1`
- **User account:**
  - Your real name: `oracle1`
  - Username: `oracle1`
  - Password: `oracle1`
- **Support registration:** Default options
- **Support: Network Configuration**: Default (no proxy)

Note: The `sysconfig create-profile` utility launches the System Configuration Tool.

```
                              System Configuration Tool

    System Configuration Tool enables you to specify the following configuration parameters
    for your newly-installed Oracle Solaris 11 system:
    - system hostname, network, time zone and locale, user and root accounts, name
      services, keyboard layout, support

    System Configuration Tool produces an SMF profile file in
    /var/tmp/manifests/client4_profile.

    How to navigate through this tool:
    - Use the function keys listed at the bottom of each screen to move from screen to
      screen and to perform other operations.
    - Use the up/down arrow keys to change the selection or to move between input fields.
    - If your keyboard does not have function keys, or they do not respond, press ESC; the
      legend at the bottom of the screen will change to show the ESC keys for navigation
      and other functions.

 F2_Continue  F6_Help  F9_Quit
```

The System Configuration Summary should look similar to the following:

```
                              System Configuration Summary

  Review the settings below before continuing.  Go back (F3) to make changes.

  - Computer name: s11-client4
  |
  | Network:
  | Manual Configuration: net0/v4
  | IP Address: 192.168.1.145/24
  | Netmask: 255.255.255.0
  | Name service: DNS
  | DNS servers: 192.168.1.100
  | DNS Domain search list: example.com
  |
  | Time Zone: UTC
  | Locale:
  | Default Language: English
  | Language Support: English (United States)
  | Keyboard: US-English
  | Username: oracle
  v

 F2_Apply  F3_Back  F6_Help  F9_Quit
```

11. Add the system configuration profile manifest to the `custom_ai` service and view the results.

```
root@s11-server1:~# installadm create-profile -n custom_ai \
-f /var/tmp/manifests/client4_profile/sc_profile.xml       \
-p client4_profile -C /var/tmp/manifests/criteria_archive_ai.xml
Created Profile: 'client4_profile'
root@s11-server1:~# installadm list -p -n custom_ai
Service Name Profile Name    Criteria
------------ ------------    --------
custom_ai    client3_profile mac = 00:16:3e:00:01:08
             client4_profile mac = 00:16:3e:00:01:09
```

12. Validate the system configuration profile.

```
root@s11-server1:~# installadm validate -n custom_ai -p \
client4_profile
Validating static profile client4_profile...
    Passed
root@s11-server1:~#
```

Task 3: Deploying the Archive to a Network Client

After you have completed AI server configuration, it is time to test your work by deploying the unified archive to a network client.

To deploy the OS to a network client, perform the following steps:

1. Verify that the **S11-Server1** VM is running. Shut down the **S11-Desktop** VM if it is running.
2. Start the S11-Client4 VM. If the AI server is configured correctly, you should see the OS installation begin in the VM.

   Note: Perform the next step as soon as possible.
3. When the S11-Client4 system starts the GNU GRUB menu, select the `Oracle Solaris 11.3 Automated Install` boot option.

   Notes

   - When you choose this boot option, the interactive system configuration is not available to you during this OS installation. The specified Oracle Solaris Unified Archive file is used during the OS installation.
   - The archive-based installation takes about 20-30 minutes to complete.
4. After the OS installation is complete, reboot from the hard disk.

   Note: To boot from the hard disk, edit the `/OVS/running_pool/s11-client4/vm.cfg` file and change from `ncd` to `cdn`.
5. Log in as the `oracle1` user and switch to the `root` role. The password for both is `oracle1`.
6. Check the system configuration to verify that the various OS configurations, such as host name and IP addresses of the host, are the same as the source system that you used to create the recovery archive.
7. Shut down the S11-Client4 VM.

Practices for Lesson 11: Implementing System Messaging And Diagnostic Facilities

Chapter 11

Practices for Lesson 11: Overview

Practices Overview

In these practices, you are first presented with the common problems that you are asked to resolve with guidance from your senior system administrator. The problems are as follows:

- Script execution issue
- Software update failure
- Network connectivity issue
- Directory access issues

Note: Unlike the preceding practices, the solutions for each step are not provided immediately after the step. This is done intentionally to give you the opportunity to apply what you have learned about your job tasks during this course. However, you can find the solutions for each practice at the end of this document.

You will also be presented with a plan to inspect the current system and application dump facilities, which are beneficial when debugging system or application problems and monitor system resources using the DTrace utility. The following activities are covered:

- Configuring system and application crash facilities
- Analyzing applications by using DTrace one-liners and the DTrace Toolkit

Scenario

You have done a great job so far in completing each of the tasks on your predeployment checklist. Your final task is to troubleshoot specific system issues based on the information provided to you about a particular problem. In each of the practices that follow, you are given a brief description of the problem and asked to resolve the issue. You are provided with some guidance to direct your actions.

Your company would like to evaluate the system messaging and debugging facilities. Because your company also plans to use ZFS, you are asked to create disk and data failures and correct the problems.

Check your progress. You have completed installing OS on multiple hosts.

	Oracle Solaris 11 Predeployment Checklist
✓	Managing Services and Service Properties by Using SMF
✓	Managing Software Packages by Using IPS
✓	Managing Data Backup and Restore by Using ZFS
✓	Configuring the Network
✓	Administering Network Services
✓	Advanced Administration of Zones
✓	Securing the Oracle Solaris 11 OS
✓	Managing Processes and Priorities
✓	Installing Oracle Solaris 11 on Multiple Hosts
	Implementing System Messaging and Diagnostic Facilities

Practice 11-1: Troubleshooting a Script Execution Issue

Overview

In this practice, you troubleshoot a script execution issue.

Scenario

In this practice, you create a simple script called `dispinfo`. The purpose of the script is to display basic account information. However, the problem is that every time you want to execute the script, you receive permission errors.

Hint: Inspect the file permissions on the script.

Tasks

1. Verify that the S11-Server1 and S11-Desktop VMs are running.
2. If the VMs are not running, start them now. Log in to the S11-Desktop VM as the `oracle` user, and then assume the `root` role.
3. As John Holt, using the `pfedit` command, create a file called `dispinfo`.

   Question: What does this script do?
   Hint: Execute the `id` command and display the result.
4. When you try to execute the script, the system says “permission denied.”
5. Using the `chmod` command, add the `execute` permission for the owner on the `dispinfo` script.

   Note: To be able to execute the script, you need the `execute` permission on the script.

Practice 11-2: Troubleshooting a Software Update Failure

Overview

In this practice, you resolve a software update failure issue.

Scenario

In this practice, you are planning to update your system with a `diffstat` package. Before you update the system, you would like to verify that the package is available in the IPS repository. The problem is that the system cannot find a properly configured repository. You get some help from your senior system administrator to resolve the problem.

Setting Up the Scenario

To set up the scenario, log in to S11-Server1 as `oracle` with the password `oracle1`. Switch to administrator by using the same password.

Issue the following command:

```
# svcadm disable application/pkg/server
```

Hints

- Determine the correct location of the IPS repository.
- Determine whether the IPS service is enabled.

Tasks

1. Verify that the S11-Server1 and S11-Desktop VMs are running.

   If not, start them now. Log in to the S11-Desktop VM as the `oracle` user, and then assume the `root` role.

2. Using the `pkg search` command, attempt to find the `diffstat` package in the IPS repository.

   Note: Analyze the problem. The message says “`unable to contact valid package repository`,” and then again it says “`unable to contact any configured publishers`.” For training purposes, assume that you have talked about this issue with your senior system administrator, who said that you should complete the next step to fix the problem.

3. Log in to the IPS server (S11-Server1). Using the `svcadm enable` command, enable the `application/pkg/server` service.

4. Verify that you can now find the package from the S11-Desktop VM.

   Good job! Now you have investigated the problem of not being able to access the IPS repository. You corrected the situation by enabling the IPS package service and now you are able to access the IPS repository.

Practice 11-3: Troubleshooting a Network Connectivity Issue

Overview

In this practice, you resolve a network connectivity issue.

Scenario

In this practice, you plan to access S11-Desktop. The problem is that when you use the `ping` command to check the connectivity between your host and S11-Desktop, the command is not successful. You must troubleshoot and correct this problem. You get some help from your senior system administrator to resolve the problem.

Setting Up the Scenario

On S11-Server1, from the `/opt/ora/scripts` directory, execute `lab11_bug2`:

```
# ./lab11_bug2
```

Hints

- Check the current state of the network interface.
- Determine the command to correct the problem.

Tasks

1. Verify that the S11-Server1 and S11-Desktop VMs are running.
2. If the virtual machines are not running, start them now. Log in to the S11-Server1 VM as the `oracle` user, and then assume the `root` role.
3. Using the `ping` command, attempt to check the connectivity between S11-Server1 and S11-Desktop VMs.

   Note: You should see the message "`no route to host`," which means that the system cannot get to the specified IP address.

   Question: What should you check?

   Answer: The network interface on S11-Server1
4. Using the `ipadm` command, check whether the network interface is up.

   Question: Is the `net0` network interface up?

   Answer: No, it is down.

   Question: What are the other displayed entries in the output?

   Answer: Both are loopback addresses: one for IPv4 and the other one for IPv6.
5. Your senior system administrator advised you to use the `ipadm` command to bring up the interface.
6. Using the same `ipadm` command, verify the results.

   Question: Is `net0` up now?

   Answer: Yes
7. Use the `ping` command to check the connectivity to S11-Desktop.

   You have successfully connected to S11-Desktop because the interface is up.

Practice 11-4: Troubleshooting Directory Access Issues

Overview

In this practice, you perform two tasks:

- Troubleshooting a directory access issue
- Troubleshooting a default shell issue

Task 1: Resolving the Directory Access Issue

Scenario

You are planning to log in as John Holt and perform a few tasks. The problem is that after logging in to John's account, when you attempt to `cd` into his home directory, you get an error. You must troubleshoot and correct this problem.

Setting Up the Scenario

On S11-Server1, from the `/opt/ora/scripts` directory, execute `lab11_bug3`:

```
# ./lab11_bug3
```

Hints

- Check the permissions of the `/export` directory.
- Check the permissions of the `/export/test` directory.
- Check the permissions of the `/export/test/bug` directory.

1. Verify that the S11-Server1 virtual machine is running. If the virtual machine is not running, start it now.
2. Log in to the S11-Server1 virtual machine as the `oracle` user, and then assume the `root` role.
3. Log in to John Holt's account by using the `su` command. Attempt to `cd` into the `/export/test/bug` directory.

   Note: The system displays a "`no permissions`" message. Investigate the cause in the subsequent steps.
4. Exit back to the administrator account and check the permissions on the intervening directories (`/export/test` and `/export/test/bug`).

   Note: It looks like the `/export/test` and `/export/test/bug` directories were created by the `root` user.

   Question: What permission does John Holt need to be able to `cd` into these two directories?

   Answer: `x` (`execute`)

   Question: Do they have the required permission for the non-`root` users to `cd` into these directories?

   Answer: No. The non-`root` users require execute permission.

5. Using the `chmod` command, change permissions on the directories. Verify the results.

   Question: Are the required permissions in place?

   Answer: *Yes*
6. Log in to John Holt's account and verify that the issue has been corrected.

   You have resolved the issue of access to the directories. You have corrected the permissions, and this has addressed the access problem.

Task 2: Resolving the Default Shell Issue

Scenario

You notice that a user called `sstudent` has been created with the default shell of `bourne`. The problem is that when you log in as `sstudent` and attempt to verify the default shell, it turns out to be a different shell. You must troubleshoot and take corrective action if needed.

Hints

- Check the default shell assigned to the `sstudent` user.
- View the man pages for the default `bourne` shell.
- Determine the relationship between both shells.

1. Verify that the S11-Server1 virtual machine is running.
2. If the virtual machine is not running, start it now. Log in to the S11-Server1 virtual machine as the `oracle` user, and then assume the `root` role.
3. Use the `cat` command to display the `/etc/passwd` file. Determine the default shell configuration for the `sstudent` user.

   Question: What is the default shell for the `sstudent` account?

   Answer: `sh` (Bourne shell)
4. Log in to the `sstudent` account and issue the `ps` command to determine the default shell.

   Note: The default shell is displayed as `ksh93`. Why? Find out in the next step.
5. Using the `man` command, display the man pages for the `bourne` shell (`sh`) and the `ksh93` shell.

   Question: What do you conclude from this analysis?

   Answer: If the `sh` shell (`bourne` shell) is assigned to a user as a default, you are given the `ksh93` shell automatically.

   Note: The `ksh93` is an improved version of the `bourne` shell and the `korn` shell.
6. Exit the `sstudent` account.

   You have successfully investigated the issue of the default shell. Because you have determined that it is not a problem, it does not need correction. However, you can explain to the user the reason a different shell is displayed.

Practice 11-5: Configuring System and Application Crash Facilities

Overview

In this practice, you work with the configuration of dump facilities. In case of system failures, you need to inspect the system facilities that are causing system crashes. Similarly, if your supported business applications fail, you can check the process that is failing. This information is helpful for an application analyst. This practice includes the following activities:

- Configuring system crash facilities
- Configuring dump facilities for business application failure

Note: The contents of your display may be different from the displays in this practice.

Task 1: Configuring System Crash Facilities

The following activities are included in this task:

- Displaying system dump configuration
- Determining the location of the dump device
- Changing the dump device
- Creating a system dump
- Analyzing and displaying the dump files
- Resetting the dump device to a ZFS device

1. Verify that the S11-Desktop virtual machine is running.

   If the virtual machine is not running, start it now. Log in to the S11-Desktop virtual machine as the `oracle` user. Use `oracle1` as the password. Assume administrator privileges.

```
oracle@s11-desktop:~$ su -
Password:
Oracle Corporation    SunOS 5.11     11.3       September 2015
```

2. Use the `dumpadm` command to display the system dump configuration.

```
root@s11-desktop:~# dumpadm
Dump content      : kernel with ZFS metadata
Dump device       : /dev/zvol/dsk/rpool/dump (dedicated)
Savecore directory: /var/crash
Savecore enabled  : yes
Save compressed   : on
```

Where is the dump device pointing to? *The default `rpool`*

Can you display the device? *Yes, by using the `zfs list` command*

```
root@s11-desktop:~# zfs list rpool/dump
NAME         USED  AVAIL  REFER  MOUNTPOINT
rpool/dump  1.03G  29.5G  1.00G  -
```

Which pool does this dump device belong to? *It belongs to* `rpool`.
How much space is allocated to the dump device? *1.03 GB*

3. Use the `format` command to partition `c2t5d0` and allocate 800 MB to slice 3.

```
root@s11-desktop:~# format
Searching for disks...done


AVAILABLE DISK SELECTIONS:
       0. c2t0d0 <Unknown-Unknown-0001-26.00GB>
          /xpvd/xdf@51712
       1. c2t2d0 <Unknown-Unknown-0001-2.00GB>
          /xpvd/xdf@51744
       2. c2t3d0 <Unknown-Unknown-0001-2.00GB>
          /xpvd/xdf@51760
       3. c2t4d0 <Unknown-Unknown-0001-2.00GB>
          /xpvd/xdf@51776
       4. c2t5d0 <Unknown-Unknown-0001-2.00GB>
          /xpvd/xdf@51792
       5. c2t6d0 <Unknown-Unknown-0001 cyl 1023 alt 0 hd 128 sec 32>
          /xpvd/xdf@51808
       6. c2t7d0 <Unknown-Unknown-0001 cyl 1023 alt 0 hd 128 sec 32>
          /xpvd/xdf@51824
       7. c2t8d0 <Unknown-Unknown-0001-4.79GB>
          /xpvd/xdf@51840
Specify disk (enter its number): 4
```

Consult your instructor if you need assistance in formatting the disk.

4. Use the `dumpadm` command to change the dump device to the `/dev/dsk/c2t5d0s3` slice that you just formatted.

```
root@s11-desktop:~# dumpadm -d /dev/dsk/c2t5d0s3
      Dump content: kernel with ZFS metadata
       Dump device: /dev/dsk/c2t5d0s3 (dedicated)
Savecore directory: /var/crash
  Savecore enabled: yes
   Save compressed: on
```

What is the purpose of changing the dump device? *Because you want to use another location (in this case, slice 3 on the* `c2t5d0` *disk) on a dedicated basis.*

One reason can be that your existing dump device is running out of space and you have storage space available on another disk or slice.

5. Check whether the specified `savecore` directory exists. If not, create it by using the `mkdir` command.

```
root@s11-desktop:~# ls /var/crash
```

6. Use the `savecore` command to dump the current system state, essentially the memory contents.

```
root@s11-desktop:~# savecore -L
dumping to /dev/dsk/c2t5d0s3, offset 65536, content: kernel sections:
zfs
 0:01  68% done (kernel)
 0:01  84% done (kernel)
 0:01 100% done (zfs)
100% done: 105737 (kernel) + 18700 (zfs) pages dumped, dump succeeded
savecore: System dump time: Fri Mar  7 07:41:05 2014

savecore: Saving compressed system crash dump files in directory
/var/crash/data/504418a9-291b-462b-9965-8e1a3f266cb6
savecore: Decompress all crash dump files with '(cd
/var/crash/data/504418a9-291b-462b-9965-8e1a3f266cb6 && savecore -v
0)' or individual files with 'savecore -vf /var/crash/data/504418a9-
291b-462b-9965-8e1a3f266cb6/vmdump{,-<secname>}.0'
root@s11-desktop:~# ls /var/crash
0     bounds    data
```

Note there are only two directories under `/var/crash`.

7. Decompress the dump file by using the `savecore` command.

```
root@s11-desktop:~# cd /var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6
root@s11-desktop:/var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6# savecore –v 0
savecore: System dump time: Fri Mar  7 07:41:05 2014

savecore: saving system crash dump in /var/crash/data/504418a9-
291b-462b-9965-8e1a3f266cb6/vmcore.0
Constructing corefile /var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6/vmcore.0
 0:03 100% done: 105737 of 105737 pages saved
13579 (12%) zero pages were not written
dump decompression took 0 minutes and 3 seconds
savecore: saving system crash dump in /var/crash/data/504418a9-
291b-462b-9965-8e1a3f266cb6/vmcore-zfs.0
Constructing corefile /var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6/vmcore-zfs.0
 0:01 100% done: 18700 of 18700 pages saved
158 (0%) zero pages were not written
dump decompression took 0 minutes and 1 seconds
```

What are the contents of the `vmdump.0` file? *It contains the recently created dump in compressed format.*

8. Use the `cd` command to switch to the crash directory. Analyze the newly created files.

```
root@s11-desktop:/var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6# ls
vmcore-zfs.0  vmcore.0      vmdump-zfs.0  vmdump.0
root@s11-desktop:/var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6# cd /var/crash
root@s11-server1:/var/crash# file bounds
bounds:        ascii text
```

Because `bounds` is a text file, you can use the `cat` command to look at it.

```
root@s11-server1:/var/crash# cat bounds
1
```

Can you guess what `1` represents? *Dump number 1.*

9. Now analyze the `vmcore` dump file.

```
root@s11-desktop:~# cd /var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6
root@s11-desktop:/var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6# file vmcore.0
vmcore.0: SunOS 5.11 11.3 64-bit Intel live dump from 's11-
desktop'
```

This is your uncompressed dump file. Use the `strings` command to display its contents.

```
root@s11-desktop:/var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6# strings vmcore.0 | more
i86pc
504418a9-291b-462b-9965-8e1a3f266cb6
SunOS
s11-desktop
5.11
11.3
i86pc
kernel
core kernel pages
ZFS metadata (ZIO buffers)
.symtab
.strtab
```

```
.shstrtab
_END_
_START_
__return_from_main
__unsupported_cpu
.dtrace_induced
dtrace_badflags
dtrace_badtrap
_lwp_rtt
freq_tsc_loop
freq_tsc_perf_loop
freq_tsc_increase_count
freq_tsc_pit_did_not_wrap
…
…
…
```

What do the contents represent? *The processes that are running in memory currently*

10. Analyze the `vmdump` file.

```
root@s11-desktop:/var/crash/data/504418a9-291b-462b-9965-8e1a3f266cb6# file vmdump.0
vmdump.0:          SunOS 5.11 11.3 64-bit Intel compressed live dump from 's11-desktop'
root@s11-desktop:/var/crash/data/504418a9-291b-462b-9965-8e1a3f266cb6# strings vmdump.0 | more
i86pc
504418a9-291b-462b-9965-8e1a3f266cb6
SunOS
s11-desktop
5.11
11.3
i86pc
kernel
core kernel pages
ZFS metadata (ZIO buffers)
.symtab
.strtab
.shstrtab
_END_
_START_
__return_from_main
__unsupported_cpu
.dtrace_induced
```

```
dtrace_badflags
dtrace_badtrap
_lwp_rtt
freq_tsc_loop
freq_tsc_perf_loop
freq_tsc_increase_count
freq_tsc_pit_did_not_wrap
…
…
…
```

Does it look like a copy of the `vmcore.0` file? *Yes*

11. Now use the `dumpadm` command to set the dump device back to the ZFS volume.

```
root@s11-desktop:/var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6# dumpadm -d /dev/zvol/dsk/rpool/dump
      Dump content: kernel with ZFS metadata
       Dump device: /dev/zvol/dsk/rpool/dump (dedicated)
Savecore directory: /var/crash
  Savecore enabled: yes
   Save compressed: on
```

Recommended best practice: Always use the ZFS pool dump device. The reason is that you will have all the system-critical files in one place, in `rpool`.

```
root@s11-desktop:/var/crash/data/504418a9-291b-462b-9965-
8e1a3f266cb6# cd
root@s11-desktop:~#
```

Task 2: Configuring Dump Facilities for Business Application Failure

Task 2A: Configuring the Global File Path Pattern

The following activities are covered in this task:

- Displaying the current dump configuration
- Specifying the global file path pattern
- Generating the core dump
- Displaying the core dump

1. Verify that the S11-Desktop virtual machine is running.
   If the virtual machine is not running, start it now. Log in to the S11-Desktop system as the `oracle` user. Use `oracle1` as the password. Assume administrator privileges.

```
oracle@s11-desktop:~$ su -
Password:
Oracle Corporation    SunOS 5.11     11.3       September 2015
root@s11-desktop:~#
```

2. Use the `coreadm` command to display the current default dump configuration for the applications.

```
root@s11-desktop:~# coreadm
     global core file pattern:
     global core file content: default
Kernel zone core file pattern:
       init core file pattern: core
       init core file content: default
            global core dumps: disabled
       kernel zone core dumps: disabled
       per-process core dumps: enabled
      global setid core dumps: disabled
 per-process setid core dumps: disabled
     global core dump logging: disabled
root@s11-desktop:~#
```

   Why is the `per-process core dumps` option enabled? *For business application processes. If they terminate abnormally, you want to capture the critical information in the core dump.*

   Why is the `global core dumps` option disabled? *You do not want to create a global dump every time an application process fails.*

3. Using the `mkdir` command, create the `/var/core` directory.

```
root@s11-desktop:~# mkdir /var/core
```

   You are creating this directory for the global dump location.

4. Use the `coreadm` command to enable global logging and configure the global core file pattern. Verify the results.

```
root@s11-desktop:~# coreadm -e log
root@s11-desktop:~# coreadm -e global -g /var/core/core.%f.%p
root@s11-desktop:~# coreadm
     global core file pattern: /var/core/core.%f.%p
     global core file content: default
       init core file pattern: core
       init core file content: default
            global core dumps: enabled
       per-process core dumps: enabled
```

```
      global setid core dumps: disabled
 per-process setid core dumps: disabled
     global core dump logging: enabled
```

You enabled global core dump logging to generate a message when the system creates a global core file.

How would you interpret the global core file pattern? *The directory is specified as* `/var/core`*. The dump files will be named* `core.%f.%p` *(*`%f` *for the file or the program being executed,* `%p` *for the process ID).*

5. Create a `dumpdir` in the `/var/tmp` directory. Then `cd` to `/var/tmp/dumpdir`.

```
root@s11-desktop:~# mkdir /var/tmp/dumpdir
root@s11-desktop:~# cd /var/tmp/dumpdir
root@s11-desktop:/var/tmp/dumpdir#
```

You are creating this directory for the system to create a core file in it.

6. Using the `ps` command, display the process ID of the current shell process. Use the `kill -8` command to kill the shell process.

```
root@s11-desktop:/var/tmp/dumpdir# ps
  PID TTY        TIME CMD
 1554 pts/1      0:00 bash
 1553 pts/1      0:00 su
 1672 pts/1      0:00 ps
root@s11-desktop:/var/tmp/dumpdir# kill -8 1554
```

Normally, this would kill your shell process and your terminal window would disappear. However, you are logged in to the `root` account by using the `su` command. Therefore, your invoked shell process will be terminated and you will go back to the `oracle` user.

7. Verify that the system generated a core file in the `dumpdir` directory.

```
oracle@s11-desktop:~$ su –
Password: oracle1
Oracle Corporation    SunOS 5.11     11.3       September 2015
root@s11-desktop:~#
```

Switch to `/var/tmp/dumpdir` if the system takes you out of this directory.

```
root@s11-desktop:~# cd /var/tmp/dumpdir
root@s11-desktop:/var/tmp/dumpdir# ls
core
root@s11-desktop:/var/tmp/dumpdir# file core
core:          ELF 64-bit LSB core file AMD64 Version 1, from
'bash'
```

The system has created the core file in the "current directory," which is the current directory at the time of dump creation.

8. Use the `cd` command to switch to the `/var/core` directory and examine the dump created when you killed the `bash` process.

```
root@s11-desktop:/var/tmp/dumpdir# cd /var/core
root@s11-desktop:/var/core# ls
core.bash.1554
root@s11-desktop:/var/core# file core*
core.bash.1554:ELF 64-bit LSB core file AMD64 Version 1, from
'bash'
root@s11-desktop:/var/core# strings core.bash.1554 | more
CORE
bash
-bash
CORE
i86pc
CORE
CORE
CORE
CORE
bash
-bash
>-IA
CORE
CORE
i86pc
CORE
CORE
SunOS
s11-desktop
5.11
11.3
i86pc
CORE
CORE
CORE
CORE
Effective
Inheritable
Permitted
Limit
contract_event
```

```
contract_identity
contract_observer
cpc_cpu
dtrace_kernel
dtrace_proc
dtrace_user
file_chown
file_chown_self
file_dac_execute
file_dac_read
...
...
...
(output truncated)
(CTRL + C)
```

The `strings` command was able to convert the encoded contents to some extent. However, this file will be analyzed by the dump analyzing utilities.

The output may vary from system to system.

9. Use the `tail` command to view the dump creation message in `syslog`.

```
root@s11-desktop:/var/core# tail /var/adm/messages
Oct  7 07:41:05 s11-desktop genunix: [ID 100000 kern.notice]
Oct  7 07:41:07 s11-desktop last message repeated 2 times
Oct  7 07:41:07 s11-desktop genunix: [ID 161914 kern.notice] ^M100% done:
Oct  7 07:41:07 s11-desktop genunix: [ID 425971 kern.notice] 105737 (kernel)
Oct  7 07:41:07 s11-desktop genunix: [ID 646760 kern.notice]  +
Oct  7 07:41:07 s11-desktop genunix: [ID 425971 kern.notice] 18700 (zfs)
Oct  7 07:41:07 s11-desktop genunix: [ID 383570 kern.notice]  pages dumped,
Oct  7 07:41:07 s11-desktop genunix: [ID 851671 kern.notice] dump succeeded
Oct  7 07:57:52 s11-desktop genunix: [ID 454863 kern.info] dump on
/dev/zvol/dsk/rpool/dump size 1024 MB
Oct  7 09:25:04 s11-desktop genunix: [ID 603404 kern.notice] NOTICE: core_log:
bash[1554] core dumped: /var/core/core.bash.1554
root@s11-desktop:/var/core# cd
root@s11-desktop:~#
```

Did you configure the dump facilities to include this message here? *Yes, by using the* `coreadm –e log` *command.*

Task 2B: Configuring the Per-Process File Path Configuration

The following activities are covered in this task:

- Enabling per-process dump generation
- Specifying per-process generation

1. Verify that the S11-Desktop virtual machine is running.

If the virtual machine is not running, start it now. Log in to the S11-Desktop virtual machine as the `oracle` user. Use `oracle1` as the password. Assume administrator privileges.

```
oracle@s11-desktop:~$ su -
Password:
Oracle Corporation    SunOS 5.11     11.3       September 2014
root@s11-desktop:~5
```

2. Use the `coreadm` command to display the current dump configuration for the applications.

```
root@s11-desktop:~# coreadm
     global core file pattern: /var/core/core.%f.%p
     global core file content: default
Kernel zone core file pattern:
       init core file pattern: core
       init core file content: default
            global core dumps: enabled
       kernel zone core dumps: disabled
       per-process core dumps: enabled
      global setid core dumps: disabled
 per-process setid core dumps: disabled
     global core dump logging: enabled
```

If the `per-process core dumps` option is disabled, perform step 3 to enable it; otherwise, skip step 3. The disable setting means that for individual processes, no dumps will be generated.

3. (Optional) Using the `coreadm` command, enable the per-process dump configuration. Verify the results.

```
root@s11-desktop:~# coreadm -e process
root@s11-desktop:~# coreadm
     global core file pattern: /var/core/core.%f.%p
     global core file content: default
       init core file pattern: core
       init core file content: default
            global core dumps: enabled
       per-process core dumps: enabled
      global setid core dumps: disabled
 per-process setid core dumps: disabled
     global core dump logging: enabled.
```

Is the `per-process core dumps` option enabled? *Yes, it is.*

4. Using the `su` command, log in to John Holt's account.

```
root@s11-desktop:~# su - jholt
Oracle Corporation    SunOS 5.11     11.3       September 2015
jholt@s11-desktop:~$
```

5. Create a directory called `corefiles` in your home directory.

```
jholt@s11-desktop:~$ mkdir corefiles
```

You are creating this directory for the system to create a core file in it.

6. Using the `ps` command, display the process ID of the current shell process. Use the `coreadm` command to display the per-process file for John.

```
jholt@s11-desktop:~$ ps
  PID TTY         TIME CMD
 1704 pts/1     0:00 bash
 1709 pts/1     0:00 ps
jholt@s11-desktop:~$ coreadm 1704
1704:      core   default
```

Currently, if any of the processes created by John are aborted, the default core file will be created.

7. Use the `coreadm` command to configure the per-process file path.

```
jholt@s11-desktop:~$ coreadm -p $HOME/corefiles/%f.%p $$
jholt@s11-desktop:~$ coreadm 1704
1704:      /export/home/jholt/corefiles/%f.%p       default
```

Has the display changed? *Yes, now the new per-process file path pattern has taken effect.*

8. Use the `kill` command to kill the `bash` process.

```
jholt@s11-desktop:~$ kill -8 1704
root@s11-desktop:~#
```

Because John's `bash` process is killed, you are back to the `root` role. Log in to John's account again.

```
root@s11-desktop:~# su - jholt
Oracle Corporation    SunOS 5.11     11.3       September 2015
jholt@s11-desktop:~$
```

9. After switching to the `corefiles` directory, use the `file` command to display the type of dump file created for John.

```
jholt@s11-desktop:~$ cd corefiles
jholt@s11-desktop:~/corefiles$ file bash*
bash.1704:      ELF 64-bit LSB core file AMD64 Version 1, from
'bash'
```

How can you display the contents of this dump file? *By using the `strings` command as in the previous task*

Practice 11-6: Analyzing Applications at Run Time by Using DTrace One-Liners

Overview

DTrace is an observability technology that helps you examine the behavior of user programs and applications as well as the OS in development and in production. DTrace does the following:

- Examines the entire software stack
- Determines the root cause of performance problems
- Tracks the source of aberrant behavior

In this practice, you work with DTrace one-liners.

Notes

- Although the printed output from the DTrace commands in this practice are examples, your own output should be similar.
- When executing the DTrace one-liners in this practice, let them run for several seconds to enable DTrace to collect a good data sample. Press Ctrl + C to terminate DTrace.

Tasks

To practice using DTrace one-liners, perform the following steps:

1. Log in to the S11-desktop VM as the `oracle` user with the password `oracle1`.
2. Run the `su` command to assume primary administrator privileges.

```
oracle@s11-desktop:~$ su –
Password: oracle1
Oracle Corporation      SunOS 5.11        11.3        September 2015
root@s11-desktop:~#
```

3. Create a list of DTrace probes.

```
root@s11-desktop:~# dtrace -l
   ID   PROVIDER     MODULE                          FUNCTION NAME
    1     dtrace                                              BEGIN
    2     dtrace                                                END
    3     dtrace                                              ERROR
    4        fbt     lofi                  lofi_lookup_ctrl return
    7        fbt     lofi           lofi_create_minor_nodes entry
    8        fbt     lofi           lofi_create_minor_nodes return
    9        fbt     lofi                   lofi_create_dev entry
   10        fbt     lofi                   lofi_create_dev return
   11        fbt     lofi                   lofi_online_dev entry
   12        fbt     lofi                   lofi_online_dev return
   13        fbt     lofi                       lofi_attach entry
   14        fbt     lofi                       lofi_attach return
<output truncated>
```

4. Create a list of DTrace providers.

```
root@s11-desktop:~# dtrace -l | perl -pe 's/^.*?\S+\s+(\S+?) ([0-
9]|\s).*/\1/' | sort| uniq
48521        fbt cpu_ms.GenuineIntel
gintel_gentopo_ereport_create_resource_elem entry
48522        fbt cpu_ms.GenuineIntel
gintel_gentopo_ereport_create_resource_elem return
48523        fbt cpu_ms.GenuineIntel gintel_ereport_create_resource_elem entry
48524        fbt cpu_ms.GenuineIntel gintel_ereport_create_resource_elem return
48525        fbt cpu_ms.GenuineIntel
nehalem_ep_ereport_add_memory_error_counter entry
48526        fbt cpu_ms.GenuineIntel
nehalem_ep_ereport_add_memory_error_counter return
cpu_ms.GenuineIntel
dtrace
fbt
fsinfo
io
ip
iscsi
kerberos542
ldapcachemgr461
libpython2.7.so.1.0
lockstat
mib
nfsv4
perl8231
proc
profile
PROVIDER
sched
scsi_vhci_f_asym_emc
scsi_vhci_f_asym_lsi
scsi_vhci_f_asym_sun
scsi_vhci_f_sym_emc
scsi_vhci_f_sym_hds
sdt
sftp6633
sftp6763
shadowfs
syscall
sysevent
sysinfo
tcp
udp
vm
vminfo
Xserver739
root@s11-desktop:~#
```

5. Generate activity on the system by writing zeros to `/dev/null`.

```
root@s11-desktop:~# dd if=/dev/zero of=/dev/null &
[1] 5823
root@s11-desktop:~# dd if=/dev/zero of=/dev/null &
[2] 5824
root@s11-desktop:~# dd if=/dev/zero of=/dev/null &
[3] 5825
root@s11-desktop:~# dd if=/dev/zero of=/dev/null &
[4] 5826
root@s11-desktop:~#
```

6. Determine the number of system calls that are executed by the CPUs.

```
root@s11-desktop:~# dtrace -n 'syscall:::entry { @[probefunc] = count
(); }'

dtrace: description 'syscall:::entry ' matched 213 probes
^C

  fcntl                                                            1
  mmap                                                             1
  schedctl                                                         1
  sigpending                                                       1
  fstatat64                                                        2
  getdents64                                                       2
  mkdirat                                                          2
  modctl                                                           2
  setgid                                                           2
  statvfs                                                          2
  lseek                                                            3
  setcontext                                                       3
  sysconfig                                                        3
  waitsys                                                          3
  getmsg                                                           4
  putmsg                                                           4
  setuid                                                           4
  sigaction                                                        4
  brk                                                              6
  getpid                                                           9
  close                                                           11
  openat                                                          11
  lwp_sigmask                                                     13
  privsys                                                         20
  getuid                                                          22
  gtime                                                           30
  writev                                                          34
  setitimer                                                       38
  fstatat                                                         39
```

```
  doorfs                                                       44
  lwp_cond_wait                                                52
  lwp_park                                                     73
  nanosleep                                                   101
  pollsys                                                     108
  recv                                                        189
  p_online                                                    256
  clock_gettime                                               260
  ioctl                                                       874
  write                                                   1131451
  read                                                    1131504
root@s11-desktop:~#
```

7. Determine the number of interrupts that are handled by each CPU.

```
root@s11-desktop:~# dtrace -n 'sdt:::interrupt-start { @num[cpu] =
count(); } '
dtrace: description 'sdt:::interrupt-start ' matched 1 probe
^C
        0             1517
        1             1618
root@s11-desktop:~#
```

8. Terminate the `dd` processes.

```
root@s11-desktop:~# pkill dd
[1]   Terminated              dd if=/dev/zero of=/dev/null
[3]   Terminated              dd if=/dev/zero of=/dev/null
```

Note: The command output or values may vary.

9. Generate the disk I/O activity by using the following script:

```
root@s11-desktop:~# while [ 1 ]
> do
> tar cf /var/tmp/disk1.tar /opt/ora/scripts/*
> rm /var/tmp/disk1.tar
> done&
[1] 10288
```

10. Determine the write size distribution by process.

```
root@s11-desktop:~# dtrace -n 'sysinfo:::writech { @dist[execname] =
quantize(arg0); }'
dtrace: description 'sysinfo:::writech ' matched 4 probes
^C

  bash
           value  ------------- Distribution ------------- count
              -1 |                                         0
               0 |@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@ 155590
               1 |                                         0
```

```
  dtrace
           value  ------------- Distribution ------------- count
               0 |                                         0
               1 |@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@@ 1
               2 |                                         0
...
...
...

  tar
           value  ------------- Distribution ------------- count
            2048 |                                         0
            4096 |@@@@@@@@@@@@@@@@@@@@                     11
            8192 |@@@@@@@@@@@@@@@@@@@@                     11
           16384 |                                         0

root@s11-desktop:~#
```

11. Determine the read size distribution by process.

```
root@s11-desktop:~# dtrace -n 'sysinfo:::readch { @dist[execname] =
quantize(arg0); }'
dtrace: description 'sysinfo:::readch ' matched 4 probes
^C
...
...
...
  tar
           value  ------------- Distribution ------------- count
              -1 |                                         0
               0 |@@@@@@@@@@@@@@@@@@                       126
               1 |                                         0
               2 |                                         0
               4 |                                         0
               8 |                                         0
              16 |@@@                                      18
              32 |                                         0
              64 |@@@                                      18
             128 |@@@@@                                    36
             256 |@@@@@                                    36
             512 |                                         0
            1024 |@@@                                      18
            2048 |@@@                                      18
            4096 |@@@                                      18
            8192 |                                         0

root@s11-desktop:~#
```

12. Determine the physical I/O to ZFS pools, physical disks, disk volumes, and NFS.

```
root@s11-desktop:~# dtrace -n 'io:::start { @[pid, execname] =
sum(args[0]->b_bcount); }'
dtrace: description 'io:::start ' matched 6 probes
^C


        5  zpool-rpool                                  382976
root@s11-desktop:~#
```

13. Kill the disk I/O script.

```
root@s11-desktop:~# pkill bash
...
```

14. Generate network activity by running the following command:

```
root@s11-desktop:~# ping -s 192.168.1.255 > /dev/null&
[1] 6200
root@s11-desktop:~#
```

15. Determine the number of received packets by host address.

```
root@s11-desktop:~# dtrace -n 'ip:::receive { @[args[2]->ip_saddr] =
count(); }'
dtrace: description 'ip:::receive ' matched 5 probes
^C


  192.168.1.X                                                    18
root@s11-desktop:~#
```

16. Kill the `ping` process.

```
root@s11-desktop:~# pkill ping
[1]+  Terminated              ping -s 192.168.1.255 > /dev/null
root@s11-desktop:~#
```

Practice 11-7: Analyzing Applications at Run Time by Using the DTrace Toolkit

Overview

In this practice, you use the DTrace Toolkit.

Note: Although the printed output from the commands in this practice are examples, your own output should be similar.

Task

Perform the following steps:

1. Log in to the Soll11-desktop VM as the `oracle` user with the password `oracle1`.
2. Run the `su` command to assume administrator privileges.

```
oracle@s11-desktop:~$ su -
Password: oracle1
Oracle Corporation      SunOS 5.11        11.3        September 2015
root@s11-desktop:~#
```

3. Verify the DTrace Toolkit installation.

```
root@s11-desktop:~# pkg info dtrace-toolkit
          Name: system/dtrace/dtrace-toolkit
       Summary: DTraceToolkit 0.99
   Description: The DTraceToolkit is a collection of useful, documented
DTrace
                scripts
      Category: Development/System
         State: Installed
     Publisher: solaris
       Version: 0.99
 Build Release: 5.11
        Branch: 0.175.3.0.0.30.0
Packaging Date: August 21, 18:47:48 2015
          Size: 2.91 MB
          FMRI: pkg://solaris/system/dtrace/dtrace-toolkit@0.99,5.11-
0.175.3.0.0.30.0:20150821T155044Z
```

Install the **`dtrace-toolkit`**, if it is not installed.

```
root@s11-desktop:~# pkg install dtrace-toolkit
No updates necessary for this image.
Planning linked: 1/1 done
root@s11-desktop:~#
```

4. Add the DTrace Toolkit to the user profile.

```
root@s11-desktop:~# pwd
/root
root@s11-desktop:~# vi .profile
...
```

```
export PATH=/usr/bin:/usr/sbin:/usr/dtrace/DTT/Bin
export MANPATH=/usr/dtrace/DTT/Man:/usr/share/man
..
:wq!
root@s11-desktop:~# . .profile
```

Verify the path by using the `echo` command.

```
root@s11-desktop:~# echo $PATH
/usr/bin:/usr/sbin:/usr/dtrace/DTT/Bin
root@s11-desktop:~# echo $MANPATH
/usr/dtrace/DTT/Man:/usr/share/man
root@s11-desktop:~#
```

5. In the `/usr/dtrace/DTT/Docs` directory, look at the content of the `Contents` file.

```
root@s11-desktop:~# cd /usr/dtrace/DTT/Docs
root@s11-desktop:/usr/dtrace/DTT/Docs# cat Contents
Contents - Command Summary

   The following is a list of commands found in the DTraceToolkit,
along
   with their directory location.

Generally commands that end in a ".d" are DTrace scripts, and commands
that don't are DTrace scripts wrapped in another language (eg, shell
or Perl). See the Docs/Readme for instructions for finding their docs.

DTraceToolkit/
   dexplorer            run a series of scripts and archive output
   dtruss        process syscall info. DTrace truss
   dvmstat       vmstat by PID/name/command
   errinfo       report syscall failures with details
   execsnoop            snoop process execution as it occurs
   iosnoop       snoop I/O events as they occur
   iopattern            print disk I/O pattern
   iotop         display top disk I/O events by process
   opensnoop            snoop file opens as they occur
   procsystime          analyse process system call times
   rwsnoop       snoop read/write events
   rwtop         display top read/write bytes by process
   statsnoop            snoop file stats as they occur
   Apps/
     httpdstat.d realtime httpd statistics
     nfswizard.d NFS client activity wizard
     shellsnoop  snoop live shell activity
     weblatency.d      website latency statistics
   Cpu/
```

```
     cputypes.d  list CPU types
     cpuwalk.d   measure which CPUs a process runs on
     dispqlen.d  dispatcher queue length by CPU
     intbycpu.d  interrupts by CPU
     intoncpu.d  interrput on-cpu usage
     inttimes.d  interrput on-cpu time total
     loads.d           print load averages
     runocc.d    run queue occupancy by CPU
     xcallsbypid.d     CPU cross calls by PID
   Disk/
     bitesize.d  print disk event size report
     diskhits    disk access by file offset
     hotspot.d   print disk event by location
     iofile.d    I/O wait time by filename and process
     iofileb.d   I/O bytes by filename and process
     iopending   plot number of pending disk events
     pathopens.d pathnames successfully opened count
     seeksize.d  print disk seek size report
   Docs/
     oneliners.txt     DTrace oneliners
   FS/
     fsrw.d            file system read/write event tracing
     fspaging.d  file system read/write and paging tracing
     rfsio.d           read FS I/O stats, with cache miss rate
     rfileio.d   read file I/O stats, with cache miss rate
     vopstat           vnode interface statistics
   Java/
     j_*.d       18 scripts for tracing Java using the hotspot
provider
   JavaScript/
     js_*.d            14 scripts for JavaScript with the Mozilla
provider
   Kernel/
     cputimes    print time by Kernel/Idle/Process
     cpudists    time distribution by Kernel/Idle/Process
     cswstat.d   context switch time statistics
     dnlcps.d    DNLC stats by process
     dnlcsnoop.d snoop DNLC activity
     dnlcstat    DNLC statistics
     kstat_types.d     trace kstat reads with type info
     modcalls.d  kernel function calls by module name
     priclass.d  priority distribution by scheduling class
     pridist.d   process priority distribution
     putnexts.d  trace who is putting to which streams module
     whatexec.d  examine the type of files executed
   Locks/
```

```
     lockbyproc.d      lock time by process name
     lockbydist.d      lock time distribution by process name
   Mem/
     anonpgpid.d anonymous memory paging info by PID on CPU
     minfbypid.d minor faults by PID
     minfbyproc.d      minor faults by process name
     pgpginbypid.d     pages paged in by PID
     pgpginbyproc.d    pages paged in by process name
     swapinfo.d  print virtual memory info
     vmbypid.d   virtual memory stats by PID
     vmstat.d    vmstat demo using DTrace
     vmstat-p.d  vmstat -p demo using DTrace
     xvmstat           extended vmstat demo using DTrace
   Misc/
     guess.d           guessing game
     wpm.d       words per minute tracing
     woof.d            audio alert for new processes
   Net/
     connections print inbound TCP connections by process
     icmpstat.d  print ICMP statistics
     tcpsnoop    snoop TCP network packets by process, Solaris 10 3/05
     tcpsnoop_snv      snoop TCP network packets by process, Solaris
Nevada
     tcpsnoop.d  snoop TCP network packets by process, Solaris 10 3/05
     tcpsnoop_snv.d    snoop TCP network packets by process, Solaris
Nevada
     tcpstat.d   print TCP statistics
     tcptop            display top TCP network packets by PID, Solaris
10 3/05
     tcptop_snv  display top TCP network packets by PID, Solaris
Nevada
     tcpwdist.d  simple TCP write distribution by process
     udpstat.d   print UDP statistics
   Perl/
     pl_*.d            12 scripts for tracing Perl
   Php/
     php_*.d           12 scripts for tracing Php
   Proc/
     crash.d           crashed application report
     creatbyproc.d     snoop file creat() by process name
     dappprof    profile user and lib function usage
     dapptrace   trace user and lib function usage
     fddist            file descriptor usage distribution
     fileproc.d  snoop files opened by process
     kill.d            snoop process signals
     lastwords   print syscalls before exit
     mmapfiles.d mmap'd files by process
```

```
     newproc.d   snoop new processes
     pfilestat   show I/O latency break down by FD
     pidpersec.d print new PIDs per sec
     readbytes.d read bytes by process name
     readdist.d  read distribution by process name
     rwbbypid.d  read/write bytes by PID
     rwbypid.d   read/write calls by PID
     rwbytype.d  read/write bytes by vnode type
     sampleproc  sample processes on the CPUs
     shortlived.d      check short lived process time
     sigdist.d   signal distribution by process name
     stacksize.d measure stack size for running threads
     sysbypid.d  system stats by PID
     syscallbyproc.d   system calls by process name
     syscallbypid.d    system calls by process ID
     threaded.d  sample multi-threaded CPU usage
     topsysproc  display top syscalls by process name
     writebytes.d      write bytes by process name
     writedist.d write distribution by process name
   Python/
     py_*.d            14 scripts for tracing Python
   Shell/
     sh_*.d            15 scripts for tracing the Bourne shell
   System/
     sar-c.d           sar -c demo using DTrace
     syscallbysysc.d   system calls by system call
     topsyscall  display top system call type
     uname-a.d   uname -a demo using DTrace
   Tcl/
     tcl_*.d           15 scripts for tracing Tcl
   User/
     setuids.d   snoop setuid calls
   Zones/
     zvmstat           vmstat info by zone

Total: 230 scripts
root@s11-desktop:/usr/dtrace/DTT/Docs#
```

What does the `dtruss` command do?

`dtruss` prints details on process system calls. It is like a DTrace version of `truss` but has been designed to be less intrusive than `truss`.

Look at the man page for `dtruss`. Which option prints the elapsed time in microseconds? ***`-e`***

6. View the man pages for the following scripts:
   - `iosnoop`
   - `iotop`
   - `iopattern`
   - `fddist`
   - `vopstat`
   - `threaded.d`
   - `sar-c.d`
   - `readdist.d`
   - `writedist.d`
   - `stacksize.d`
   - `rwtop`
   - `sampleproc`
   - `dexplorer`
7. Shut down the virtual machines. You have completed this practice and thus the final practice for this course. Congratulations!

Solution for Practice 11-1: Troubleshooting a Script Execution Issue

Scenario

In this practice, you create a simple script called `dispinfo`. The purpose of the script is to display basic account information. However, the problem is that every time you want to execute the script, you receive permission errors.

Hint: Inspect the file permissions on the script.

Tasks

1. Verify that the S11-Server1 and S11-Desktop VMs are running.

   If the VMs are not running, start them now. Log in to the S11-Desktop VM as the `oracle` user, and then assume the `root` role.

```
oracle@s11-desktop:~$ su -
Password:
Oracle Corporation      SunOS 5.11      11.3    September 2015
root@s11-desktop:~#
```

2. As John Holt, by using the `vi` editor, create a file called `dispinfo` as follows.

```
root@s11-desktop:~# su – jholt
Oracle Corporation      SunOS 5.11      11.3    September 2015
jholt@s11-desktop:~$ vi dispinfo
#!/bin/bash
echo Here is my userid and the group information
id
~
~
:wq
jholt@s11-desktop:~$ cat dispinfo
#!/bin/bash
echo Here is my userid and the group information
id
```

   What does this script do? *It executes the `id` command and displays the results.*

3. Using the `chmod` command, add the execute permission for the owner on the `dispinfo` script.

```
jholt@s11-desktop:~$ ./dispinfo
bash: ./dispinfo: Permission denied

jholt@s11-desktop:~$ ls -l dispinfo
-rw-r--r--   1 jholt    staff         64 Sep  6 13:27 dispinfo
jholt@s11-desktop:~$ chmod 744 dispinfo
jholt@s11-desktop:~$ ls -l dispinfo
```

```
-rwxr--r--   1 jholt    staff         64 Sep  6 13:27 dispinfo
```

To be able to execute the script, you need the execute permission on it.

4. Now run the `dispinfo` script with the newly added execute permission.

```
jholt@s11-desktop:~$ ./dispinfo
Here is my userid and the group information
uid=60005(jholt) gid=10(staff)
```

Why can the system now find your `dispinfo` script? *Because the `dispinfo` script has the right permissions*

```
jholt@s11-desktop:~$ exit
logout
root@s11-desktop:~#
```

Solution for Practice 11-2: Troubleshooting a Software Update Failure

Scenario

In this practice, you plan to update your system with a `diffstat` package. Before you update the system, you would like to verify that the package is available in the IPS repository. The problem is that the system cannot find a properly configured repository. You get some help from your senior system administrator to resolve the problem.

Setting Up the Scenario

To set up the scenario, log in to S11-Server1 as `oracle` with the password `oracle1`. Switch to administrator by using the same password.

Issue the following command:

```
# svcadm disable application/pkg/server
```

Hints

- Determine the correct location of the IPS repository.
- Determine whether the IPS service is enabled.

Tasks

1. Verify that the S11-Server1 and S11-Desktop virtual machines are running.

   If the virtual machines are not running, start them now. Log in to the S11-Desktop virtual machine as the `oracle` user, and then assume the `root` role.

```
oracle@s11-desktop:~$ su -
Password:
Oracle Corporation      SunOS 5.11      11.3    September 2015
root@s11-desktop:~#
```

2. Using the `pkg search` command, attempt to find the `diffstat` package in the IPS repository.

```
root@s11-desktop:~# pkg search diffstat
pkg: Some repositories failed to respond appropriately:
solaris:
Unable to contact valid package repository
Encountered the following error(s):
Unable to contact any configured publishers.
This is likely a network configuration problem.
Framework error: code: 7 reason: Failed connect to s11-
server.example.com:80; Connection refused
URL: 'http://s11-server.example.com' (happened 4 times)
```

   Analyze the problem.

   The message says “`Unable to contact valid package repository`,” and then again it says “`Unable to contact any configured publishers`.”

   You checked with your senior system administrator, who showed you the next steps for investigating and fixing the problem.

3. Log in to S11-Server1 as `oracle` with the password `oracle1`. Switch to the administrator account by using the same password. Display the status of the `application/pkg/server` service.

```
root@s11-server1:~# svcs application/pkg/server
STATE      STIME      FMRI
disabled    5:55:18   svc:/application/pkg/server:default
```

Because the IPS package repository service is down, you cannot find it. Enable the service, and then verify that it is online:

```
root@s11-server1:~# svcadm enable application/pkg/server
root@s11-server1:~# svcs application/pkg/server
STATE      STIME      FMRI
online      6:00:36   svc:/application/pkg/server:default
```

4. Return to the S11-Desktop virtual machine. Using the `pkg search` command, attempt to find the `diffstat` package in the repository.

```
root@s11-desktop:~# pkg search diffstat
INDEX        ACTION VALUE                                PACKAGE

pkg.description set.   The diff command compares files line by
line. Diffstat reads the output…….
…
…
…
Pkg:/text/diffstat@1.51-0.175.3.0.0.30.0
```

Success! Now you are able to access the package repository on S11-Server1.

Because this configuration was not covered in this class, you had to rely on your senior system administrator to advise you as to what actions you should take. However, if in future you are unable to find a package, you may try resolving the issue by using these commands.

Solution for Practice 11-3: Troubleshooting a Network Connectivity Issue

Scenario

In this practice, you plan to access S11-Desktop. The problem is that when you use the `ping` command to check the connectivity between your host and S11-Desktop, the command is not successful. You must troubleshoot and correct this problem. You get some help from your senior system administrator to resolve the issue.

Setting Up the Scenario

On S11-Server1, from the `/opt/ora/scripts` directory, execute `lab11_bug2`:

```
# ./lab11_bug2
```

Hints

- Check the current state of the network interface.
- Determine the command to correct the problem.

Task

1. Verify that the S11-Server1 and S11-Desktop virtual machines are running.
2. Using the `ping` command, attempt to check the connectivity between S11-Server1 and S11-Desktop (IP address: 192.168.1.200).

```
root@s11-server1:~# ping 192.168.1.200
ping: sendto No route to host
```

The message says “`No route to host`,” which means that the `ping` command cannot get to the specified IP address.

What should you check? *The network interface on* s11-server1

3. Using the `ipadm` command, check whether the network interface is up.

```
root@s11-server1:~# ipadm show-addr
ADDROBJ          TYPE     STATE      ADDR
lo0/v4           static   ok         127.0.0.1/8
net0/v4          static   down       192.168.1.100/24
lo0/v6           static   ok         ::1/128
net0/v6          addrconf ok         fe80::216:3eff:fe00:102/10
```

Is the `net0` network interface up? *No, it is down*.

What are the other entries displayed in the output? *Both are loopback addresses: one for IPv4 and the other one for IPv6.*

4. Using the `ipadm` command, bring up the interface. Verify the results.

```
root@s11-server1:~# ipadm up-addr net0/v4
```

5. Verify that the network interface is up and running.

```
root@s11-server1:~# ipadm show-addr
lo0/v4            static   ok         127.0.0.1/8
net0/v4           static   ok         192.168.1.100/24
lo0/v6            static   ok         ::1/128
net0/v6           addrconf ok         fe80::216:3eff:fe00:102/10
```

Is `net0` up now? *Yes.*

6. Use the `ping` command to check the connectivity to S11-Desktop.

```
root@s11-server1:~# ping 192.168.1.200
192.168.1.200 is alive
```

You have successfully connected to S11-Desktop because the network interface is up.

Solution for Practice 11-4: Troubleshooting Directory Access Issues

Task 1: Resolving the Access to Directory Issue

Scenario

You plan to log in as John Holt and perform some tasks. The problem is that after logging in to John Holt's account, when you attempt to `cd` into his home directory, you get an error. You must troubleshoot and correct this problem.

Setting Up the Scenario

On S11-Server1, from the `/opt/ora/scripts` directory, execute `lab11_bug3`:

```
# ./lab11_bug3
```

Hints

- Check the permissions of the `/export` directory.
- Check the permissions of the `/export/test` directory.
- Check the permissions of the `/export/test/bug` directory.

1. Verify that the S11-Server1 and S11-Desktop virtual machines are running.
2. Log in to the S11-Desktop virtual machine as the `oracle` user. Use the `ssh` command to remotely connect to the S11-Server1 VM. Log in to the S11-Server1 virtual machine as the `oracle` user. Then assume the `root` role.

```
oracle@s11-desktop:~$ ssh oracle@192.168.1.100
Password: oracle1
Oracle Corporation      SunOS 5.11      11.3    September 2015
oracle@s11-server:~$ su -
Password:
Oracle Corporation      SunOS 5.11      11.3    September 2015
root@s11-server1:~#
```

3. Log in to John Holt's account by using the `su` command. Attempt to `cd` into the `/export/test/bug` directory.

```
root@s11-server1:~# su - jholt
Oracle Corporation      SunOS 5.11      11.3    September 2015
jholt@s11-server1:~$ cd /export/test/bug
-bash: cd: /export/test/bug: Permission denied
```

Investigate the cause in the subsequent steps.

4. Exit to the superuser account and check the permissions on the intervening directories (that is, on `/export/test` and `/export/test/bug`).

```
jholt@s11-server1:~$ exit
logout
root@s11-server1:~# ls -ld /export/test
drwxr--r--   3 root   root      3 Oct 17 19:01 /export/test
root@s11-server1:~# ls -ld /export/test/bug
drwxr--r--   2 root   root      2 Oct 17 19:01 /export/test/bug
```

It looks like the `/export/test` and `/export/test/bug` directories were created by the `root` user.

What permission does John Holt need to be able to `cd` into these two directories? *He needs the* `x` *(execute) permission.*

Do the two directories have the required permissions set to enable non-`root` users to `cd` into them? *No*

5. Using the `chmod` command, change permissions on the directory and the file. Verify the results.

```
root@s11-server1:~# chmod 755 /export/test
root@s11-server1:~# chmod 755 /export/test/bug
root@s11-server1:~# ls -ld /export/test
drwxr-xr-x   3 root   root       3 Oct 17 19:01 /export/test
root@s11-server1:~# ls -ld /export/test/bug
drwxr-xr-x   2 root   root      2 Oct 17 19:01 /export/test/bug
```

Are the required permissions in place? *Yes*

6. Log in to John Holt's account and attempt to access the directories.

```
root@s11-server1:~# su - jholt
Oracle Corporation      SunOS 5.11      11.3    September 2015
jholt@s11-server1:~$ cd /export/test/bug
jholt@s11-server1:/export/test/bug~$ cd ..
jholt@s11-server1:~$ exit
logout
root@s11-server1:~#
```

Task 2: Resolving the Default Shell Issue

Scenario

You notice that a user called `sstudent` has been created with the default shell of `bourne`. The problem is that when you log in as `sstudent` and attempt to verify the default shell, it turns out to be a different shell. You must troubleshoot and take corrective action if needed.

Hints

- Check the default shell assigned to the user `sstudent`.
- View the man pages for the default `bourne` shell.
- Determine the relationship between both shells.

1. Verify that the S11-Server1 and S11-Desktop virtual machines are running.

   Use the `ssh` command to log in to S11-Server1 VM from S11-Desktop VM assuming the `root` role.

```
oracle@s11-desktop:~$ ssh oracle@192.168.1.100
Password: oracle1
Oracle Corporation      SunOS 5.11      11.3    September 2015
oracle@s11-server:~$ su -
Password:
Oracle Corporation      SunOS 5.11      11.3    September 2015
root@s11-server1:~#
```

2. Use the `cat` command to display the `/etc/passwd` file. Determine the default shell configuration for the `sstudent` user.

```
root@s11-server1:~# cat /etc/passwd
...
...
...
jholt:x:60005:10:john holt:/export/home/jholt:/bin/bash
jmoose:x:60006:10:jerry moose:/export/home/jmoose:/bin/bash
panna:x:60007:10:polly anna:/export/home/panna:/bin/bash
sstudent:x:60008:10:super student:/export/home/sstudent:/bin/sh
```

   What is the default shell for the `sstudent` account? *sh (Bourne shell)*

3. Log in to the `sstudent` account and issue the `ps` command to determine the default shell.

```
root@s11-server1:~# su - sstudent
Oracle Corporation      SunOS 5.11      11.3    September 2015
sstudent@s11-server1:~$ ps
  PID TTY         TIME CMD
 2674 pts/1       0:00 ksh93
 2668 pts/1       0:00 ps
```

The default shell is displayed as `ksh93`.

Why? Find out in the next step.

4. Using the `man` command, display the man pages for the `bourne` shell (`sh`) and the `ksh93` shell.

```
sstudent@s11-server1:~$ man sh

User Commands                                                sh(1)

NAME
      sh, jsh - standard and job control shell and command interpreter

SYNOPSIS
      /usr/bin/sh [acefhiknprstuvx] [argument]...

      /usr/xpg4/bin/sh [+ abCefhikmnoprstuvx]
          [+ o option]... [-c string]  [arg]...

      /usr/bin/jsh [acefhiknprstuvx] [argument]...

DESCRIPTION
      The /usr/bin/sh utility is a command programming language that
executes command read from a terminal or a file.
...
...
...
<Press q to quit>

sstudent@s11-server1:$ man ksh93

User Commands                                               ksh(1)

NAME
     ksh,ksh93, rksh93 - Korn Shell, a standard and  restricted
command and programming language

SYNOPSIS
     ksh [+abcefhikmnoprstuvxBCD] [-R file] [ +o option] ...
            [-] [arg ...]

     rksh [+abcefhikmnoprstuvxBCD] [-R file] [+o option] ...
            [-] [arg ...]

DESCRIPTION
     ksh is a command and programming  language  that  executes
     commands  read  from  a terminal or a file. rksh is a res-
```

```
...
...
...
<Press q to quit>
```

Note: You issued the `man sh` and `ksh` command. But the description has `ksh93` and not `sh`. `ksh93` is an improved version of the `bourne` shell and the `korn` shell.

5. Exit the `sstudent` account.

```
sstudent@s11-server1:~$ exit
root@s11-server1:~# exit
logout
oracle@s11-server1:~# exit
logout
Connection to 192.168.1.100 closed.
root@s11-desktop:~#
```