

VMware vSphere: Optimize and Scale

Lab Manual

ESXi 5.5 and vCenter Server 5.5



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VMware vSphere:

Optimize and Scale

ESXi 5.5 and vCenter Server 5.5
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Lab Manual

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Course development: Tom Thomas, Rob Nendel

Technical review: Jon Loux, Roy Freeman

Technical editing: Shalini Pallat

Production and publishing: Ron Morton, Regina About

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Lab 1

Using VMware vSphere Management Assistant

Objective: Use vSphere Management Assistant to manage ESXi hosts and virtual machines

In this lab, you will perform the following tasks:

1. Log In to the Control Center Desktop
2. License the vCenter Server System and the ESXi Host
3. Enable SSH and vSphere ESXi Shell Services
4. Log In to the vSphere Management Assistant Appliance
5. Add the vCenter Server System and the ESXi Host as Target Servers
6. Use ESXCLI Commands to Query ESXi Host Properties
7. Use the vicfg-ntp Commands to Configure NTP
8. Use vmware-cmd Commands to Manage a Virtual Machine
9. Clean Up for the Next Lab

Task 1: Log In to the Control Center Desktop

The Control Center system is the desktop that you use to perform each lab in the course. The Control Center is a virtual machine in the lab sandbox.

Use the following information from the class configuration handout:

- Standard lab password
1. Ask your instructor how to log in to the Control Center system in your lab sandbox.
For example, your instructor might ask you to use Remote Desktop Connection to connect to the Control Center system, using a fully qualified domain name (FQDN).
 2. Log in to the Control Center system as student A or student B with the standard lab password.

Task 2: License the vCenter Server System and the ESXi Host

Licenses are provided by your instructor for the VMware® vCenter Server™ virtual appliance and the VMware® ESXi™ host.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Ask your instructor for the license key.
 - VMware® vCenter™ Server Standard™ 5.x license key
 - VMware vSphere® Enterprise Plus Edition™ 5.x license key
 2. Log in to the VMware vSphere® Web Client interface.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. Log in as the VMware vSphere® administrator with the standard lab password.
 3. Assign a vCenter Server license key to the vCenter Server instance.
 - a. In the inventory tree, click **Administration** and click **Licenses**.
 - b. In the middle pane, click the **vCenter Server Systems** tab.
 - c. Select the vCenter Server system and click the **Assign License Key** link.
 - d. In the Assign License Key dialog box, select **Assign a new license key** from the drop-down menu.

- e. Type or paste your vCenter Server Standard 5.x license key in the **License Key** text box and click **Decode** to verify the key.
 - f. Click **OK**.
4. Assign the vSphere Enterprise Plus Edition 5.x license key to the ESXi host.
 - a. In the center pane, click the **Hosts** tab.
 - b. Select the ESXi host and click the **Assign License Key** link.
 - c. In the Assign License Key dialog box, select **Assign a new license key** from the drop-down menu.
 - d. Type or paste your vSphere Enterprise Plus Edition 5.x license key in the **License Key** text box and click **Decode** to verify the key.
 - e. Click **OK**.
 - f. If the ESXi host is disconnected, right-click the host and select **Connect**.
You can also connect the host from the **vCenter > Hosts and Clusters** inventory panel.

Task 3: Enable SSH and vSphere ESXi Shell Services

You can enable the SSH service for later use when logging in to the ESXi host directly using PuTTY.

Student A and student B should do this task independently.

1. In the vSphere Web Client, click the **Go Home** icon.



2. In the left panel, click **vCenter** and click **Hosts and Clusters**.
3. Expand the Hosts and Clusters inventory tree and select the ESXi host.
4. In the middle pane, click the **Manage** tab.
5. In the options list, select the **Security Profile** link.
6. In the Security Profile panel, scroll down to the **Services** section and click the **Edit** button.
7. In the Edit Security Profile dialog box, enable the SSH and the VMware vSphere® ESXi™ Shell services.
 - a. Select the **SSH** service.
 - b. Select **Start and stop with host** from the **Startup Policy** drop-down menu.

- c. Click the **Start** button.
- d. Select the **ESXi Shell** service and expand **Service Details**.
- e. Select **Start and stop with host** from the **Startup Policy** drop-down menu.
- f. Click the **Start** button.
- g. Verify that the state of both services is `Running` and click **OK**.

Task 4: Log In to the vSphere Management Assistant Appliance

You can use PuTTY to establish an SSH session to the VMware vSphere® Management Assistant appliance.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere Management Assistant administrator user name
 - Standard lab password
1. Minimize the Firefox window.
 2. On the Control Center desktop, double-click the **PuTTY** icon.
 3. In the PuTTY window, double-click the **vSphere Management Assistant** session.
 4. Log in as the vSphere Management Assistant administrator with the standard lab password.

Task 5: Add the vCenter Server System and the ESXi Host as Target Servers

vCenter Server systems and ESXi hosts can both be configured as vSphere Management Assistant target servers to simplify commands. When a typed command does not include a target server specification, the command is performed against the current target server.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vCenter Server FQDN
- ESXi FQDN
- Standard lab password

1. (Optional) To get help on commands, run the command with the `--help` parameter.

- `esxcli --help`
- `vifp --help`
- `vifptarget --help`

NOTE

Due to the formatting of the lab book, commands might appear on two lines instead of one. All commands must be typed in a single line unless otherwise indicated. All commands are case-sensitive. When working at the vSphere Management Assistant command line, you can press the up arrow key to display previous commands. When you find the desired command, use the Backspace, left arrow, and right arrow keys to modify the command as needed. Press Enter to run the command.

2. Add the vCenter Server system as a server target.

```
vifp addserver server --authpolicy fpauth --username root
```

Replace *server* with the vCenter Server FQDN.

Any user with sufficient vCenter privileges can be specified, including SSO users. `root` is used here because it is the default vCenter virtual appliance administrator account.

3. When prompted for a password, type the standard lab password and press Enter.
4. When asked to store the user name and password in the credential store, type **yes** and press Enter.
5. Add the ESXi host as a server target.

```
vifp addserver server --authpolicy fpauth --username root
```

Replace *server* with the ESXi FQDN.

6. When prompted for a password, type the standard lab password and press Enter.
7. List the configured target servers, by running the command.

```
vifp listservers
```

```
vi-admin@vma:~> vifp listservers
vc01.vclass.local      vCenter
esxi01.vclass.local    ESXi
vi-admin@vma:~> █
```

The vCenter Server system and the ESXi host should both appear in the list. Both vCenter Server instances and both hosts must be listed. You and your lab partner are both logged in and configuring target servers. Ensure that you interact only with the vCenter Server instance and ESXi host assigned to you.

Task 6: Use ESXCLI Commands to Query ESXi Host Properties

From the vSphere Management Assistant command prompt, use ESXCLI commands to query and manage ESXi hosts.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- ESXi FQDN

1. Set the ESXi host as the current target server.

```
vifptarget -s server
```

Replace *server* with the ESXi FQDN.

After running the command, the name of the target server is displayed as part of the command prompt.

```
vi-admin@vma:~> vifptarget -s esxi01.vclass.local  
vi-admin@vma:~[esxi01.vclass.local]> █
```

2. Examine the CPU characteristics on the ESXi host.

```
esxcli hardware cpu list
```

3. Use the command output to determine the CPU characteristics.

- Number of CPUs installed on the host _____
- Brand of the first CPU _____
- Family and model of the first CPU _____
- Core speed of the second CPU _____

4. Examine the ESXi host memory.

```
esxcli hardware memory get
```

5. Use the command output to determine the memory characteristics.

- Amount of physical memory _____
- NUMA node count _____

6. Determine the platform on which the ESXi software is installed.

```
esxcli hardware platform get
```

When viewing the platform information in a nested environment, such as a class hosted on the VMware vClass2 platform, the return value is VMware Virtual Platform. In non-nested environments, this command returns the name of the hardware vendor.

7. Use the command output to determine the platform characteristics.

- Product name _____
- IPMI supported status _____

8. List the software version of ESXi that is installed on the host.

```
esxcli system version get
```

9. Examine the time and date on the host.

```
esxcli hardware clock get
```

10. Determine the system host name.

```
esxcli system hostname get
```

11. Determine the system's boot device.

```
esxcli system boot device get
```

Task 7: Use the vicfg-ntp Commands to Configure NTP

From the vSphere Management Assistant command prompt, use `vicfg-ntp` commands to query and configure Network Time Protocol (NTP) settings.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- NTP server address
1. List the NTP servers that are configured on the ESXi host.

```
vicfg-ntp --list
```

NTP servers are not yet configured.

2. Stop the NTP service.

```
vicfg-ntp --stop
```

3. Add an NTP server.

```
vicfg-ntp --add server
```

Replace *server* with the NTP server address.

4. List the configured NTP server.

```
vicfg-ntp --list
```

5. Start the NTP service.

```
vicfg-ntp --start
```

Task 8: Use vmware-cmd Commands to Manage a Virtual Machine

From the vSphere Management Assistant command prompt, use `vmware-cmd` commands to manage virtual machines.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- VMX file path

1. Maximize the PuTTY window.

Many of the following commands use wide formatting.

2. Display the help information.

```
vmware-cmd --help | more
```

Press the space bar to display one page at a time. Press Q to return to the command prompt.

3. List the paths to the configuration file for each virtual machine that is registered with the ESXi target server.

```
vmware-cmd -l
```

If the target server is `esxi01.vclass.local`, the list of configuration file path names looks like this.

```
/vmfs/volumes/525c66c2-28046013-e194-005056014986/Lab16_01-A/Lab16_01-A.vmx  
/vmfs/volumes/525c66c2-28046013-e194-005056014986/Lab16_02-A/Lab16_02-A.vmx  
/vmfs/volumes/525c66c2-28046013-e194-005056014986/win01-A/win01-A.vmx  
/vmfs/volumes/525c66c2-28046013-e194-005056014986/win02-A/win02-A.vmx  
/vmfs/volumes/525dde3b-54651308-2c13-005056014986/Test01-A/Test01-A.vmx  
/vmfs/volumes/525dde3b-54651308-2c13-005056014986/Test02-A/Test02-A.vmx  
vi-admin@vma:~[esxi01.vclass.local]> █
```

Each path contains a UUID-based folder name at the third level that identifies the file system on which the virtual machine configuration file is stored.

- Determine the mapping between the UUID and the user-friendly file system name.

```
esxcli storage filesystem list
```

The first column in the command output displays the mount point, containing the UUID. The second column displays the user-friendly volume name.

- Determine the execution state of a virtual machine.

```
vmware-cmd file_path getstate
```

Replace *file_path* with the VMX file path specified in your lab configuration handout.

File and folder parameters are case-sensitive. Type the VMX path exactly as shown in the class configuration handout.

The command returns a `getstate()=off` message, indicating that the virtual machine is not powered on.

All of the remaining commands to be used in this task require the same VMX path parameter. Use the up arrow key to retrieve the previous command and modify the command to match the instructions given.

- Power on the virtual machine.

```
vmware-cmd vmx_path start
```

The command returns a `start()=1` message to indicate the ending status of the operation.

- Get the execution state of a virtual machine.

```
vmware-cmd file_path getstate
```

The command returns a `getstate()=on` message, indicating that the virtual machine is powered on.

- List all the running virtual machine processes on the ESXi target server.

```
esxcli vm process list
```

- Retrieve the platform information of the virtual machine.

```
vmware-cmd file_path getproductinfo platform
```

The command returns a `getproductinfo(platform)=vmnix-x86` message.

- Retrieve the uptime of the guest operating system in seconds.

```
vmware-cmd file_path getuptime
```

11. Determine whether VMware® Tools™ is installed on the virtual machine.

```
vmware-cmd file_path gettoolslastactive
```

The command returns 1 if VMware Tools is responding normally. Otherwise the command returns 0.

12. Create a snapshot for the virtual machine.

```
vmware-cmd file_path createsnapshot snapshot1 "Test" 0 0
```

The command returns 1 if the operation is successful.

13. Verify that the virtual machine has a snapshot.

```
vmware-cmd file_path hassnapshot
```

The command returns 1 if snapshots are defined.

14. Remove the snapshot that you created.

```
vmware-cmd file_path removesnapshots
```

The command returns 1 if the operation is successful.

15. Verify that the virtual machine has no snapshots.

```
vmware-cmd file_path hassnapshot
```

The command returns 0 if no snapshots are defined.

16. Power off the virtual machine.

```
vmware-cmd file_path stop soft
```

The command returns 1 if the operation is successful.

17. Verify that the virtual machine is powered off.

```
vmware-cmd file_path getstate
```

Task 9: Clean Up for the Next Lab

Perform the following actions to prepare for the next lab.

Student A and student B should do this task independently.

1. Minimize the PuTTY (vSphere Management Assistant session) window for use in upcoming labs.
2. Restore the minimized Firefox window.
3. In the vSphere Web Client, click the **Go Home** icon.
4. Leave the vSphere Web Client interface open in Firefox for use in upcoming labs.

Lab 2

VMware Monitoring Tools

Objective: Monitor memory, CPU, and storage performance

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Start Database Activity in a Virtual Machine
3. Examine Host and Storage Overview Charts
4. Configure Advanced Performance Charts
5. Start resxtop
6. Explore resxtop Output
7. Run resxtop in Batch Mode
8. Use Windows Performance Monitor to Display Captured Statistics
9. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client interface if it is not already open.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Open the vSphere Web Client interface if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.
 2. In the vSphere Web Client interface, click the **Home** icon.

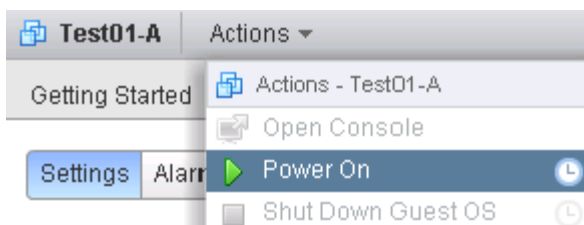
Task 2: Start Database Activity in a Virtual Machine

A script is started that generates continuous database activity so that increased CPU and datastore usage can be monitored.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
1. Power on the Linux01 virtual machine and open a console window.
 - a. In the left pane, click **vCenter** and click **Hosts and Clusters**.
 - b. Expand the Hosts and Clusters inventory tree and select the **Linux01** virtual machine.
 - c. In the center pane, select **Power On** from the **Actions** drop-down menu.



- d. In the Recent Tasks panel, monitor the power on action to completion.
 - e. Select **Open Console** from the **Actions** drop-down menu.
 - f. When prompted, log in as root with the standard lab password.
2. In the Linux01 console window, right-click the virtual machine desktop and select **Open Terminal**.
 3. In the terminal window, run the following command to generate continuous database activity.

```
./starttest1
```

The script performs continuous database operations to a medium-size database and must run uninterrupted.

```
[root@localhost ~]# ./starttest1
target= localhost n_threads= 1 ramp_rate= 10 run_time= 0 db_size_str= M
warmup_time= 1 think_time= 0
pct_newcustomers= 10 n_searches= 3 search_batch_size= 5 n_line_items= 5
virt_dir= ds2 page_type= php target_hostname=

Using .NET DateTime for measuring response time

Not generating Windows Performance Monitor Counters
Thread 0: created for User 0
Thread 0: connected to localhost
Controller (11/4/2013 9:52:07 AM): all threads running
Controller (11/4/2013 9:52:07 AM): all threads connected - issuing Start
```

Task 3: Examine Host and Storage Overview Charts

In the vSphere Web Client, use performance overview charts and advanced performance charts to review captured performance statistics.

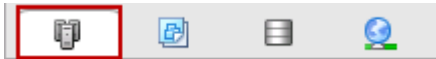
Student A and student B should do this task independently.

1. In the Firefox window, click the **vSphere Web Client** tab.
2. Review the Storage overview charts.
 - a. In the left pane, click the **Storage** icon.



- b. Expand the Storage inventory tree and select the **Shared** datastore.
- c. In the middle pane, click the **Monitor** tab and click the **Performance** button.

- d. Above the charts, verify that **Space** is selected under **View**.
 - e. Correct the selection if necessary.
 - f. Review the overview charts to find the performance values.
 - Space that is used by virtual disks, in the By File Type chart.
 - Total space that is used by the top objects, in the By Virtual Machines (Top 5) chart.
3. Review the VMware® ESXi™ host overview charts.
- a. In the left pane, click the **Hosts and Clusters** icon.



- b. In the Hosts and Clusters inventory tree, select the ESXi host.
- c. In the center pane, click the **Monitor** tab and click the **Performance** button.
- d. Above the charts, verify that **Home** is selected under **View**.
- e. Correct the selection if necessary.
- f. Review the overview charts to find the performance values.
 - The time of any significant CPU spike, in the CPU (%) chart.
 - The time of any significant latency spike, in the Disk (ms) chart.

Task 4: Configure Advanced Performance Charts

In the vSphere Web Client, use performance overview charts and advanced performance charts to review captured performance statistics.

Student A and student B should do this task independently.

1. In the chart links panel, click the **Advanced** link.
2. Collapse the links panel by clicking the << icon.

The viewable chart area can be increased by collapsing the chart links panel.

3. Above the chart graphic, click the chart **View** button and select **Memory**.

The **View** button appears above the top-right corner of the graphical chart, to the right of the chart title.

4. To the left of the **View** button, click the **Chart Options** link and customize the chart options.
 - a. In the **Chart Metrics** panel, on the left side of the window, verify that only **Memory** is selected.
 - b. For **Timespan**, select **Last day** from the drop-down menu.
 - c. For **Chart Type**, select **Stacked Graph (Per VM)** from the drop-down menu.
 - d. In the **Select object for this chart** panel, click **All** to select all the listed objects.
 - e. In the **Select counters for this chart** panel, click **None** to deselect all counters and select the **Usage** check box.
 - f. Click **Ok** to close the Chart Options window.

The customized chart displays the memory usage counter for all virtual machines that are in a running state, as well as for the ESXi host.

5. Examine the Performance Chart Legend.
 - a. Scroll down to uncover the Performance Chart Legend.
 - b. Find the counter value columns that are part of the Performance Chart Legend, appearing as the last columns in the table.

If the counter value columns are not visible, collapse the chart links panel to increase the size of the chart pane and display the value columns. If the value columns are not displayed, you must use the scroll bar each time an advanced chart is examined. Advanced charts are used extensively in many labs in this course.

- c. To examine the counter value columns, scroll to the right to uncover the value columns if necessary.

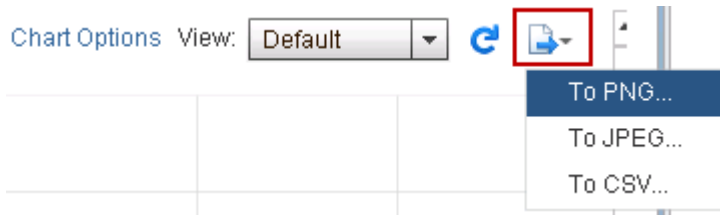
The counter value columns are the last columns displayed from left to right. For each counter, the legend table contains numerous values, representing such measurements as Latest value, Maximum value, and Minimum value.

- d. If the last column heading is not Average, use the mouse to resize one or more displayed columns so that those columns are narrower.

The Average column is the last column in the table and might not appear until more space is available because of a column resize.

- e. Point to the average column values to determine the average memory usage for both the ESXi host and the Linux01 virtual machine.

6. Export an advanced chart as a graphic image.
 - a. Scroll to the top of the chart pane.
 - b. Click the **Export** icon and select **To PNG**.



- c. In the **Select location for download** dialog box, click the **Desktop** icon and click **Save**.
- d. Minimize the Firefox window.
- e. On the Control Center desktop, double-click the **exported.png** file to view the exported chart image.
- f. Close the image viewer window.

Keep the Firefox browser window minimized for the next task.

Task 5: Start `resxtop`

The `esxtop` and `resxtop` commands are used to view and analyze real-time ESXi host performance statistics. The `resxtop` command is available from the VMware vSphere® Management Assistant command line. The `esxtop` command is available from the VMware vSphere® ESXi™ Shell.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere Management Assistant administrator user name
 - Standard lab password
 - ESXi FQDN
1. Restore the PuTTY (vSphere Management Assistant session) window that was minimized at the end of the previous lab.

2. If the PuTTY window is closed, log in to the vSphere Management Assistant and set the ESXi host as the target server.
 - a. On the Control Center desktop, double-click the **PuTTY** shortcut.
 - b. In the PuTTY window, double-click the **vSphere Management Assistant** session.
 - c. Log in as the vSphere Management Assistant administrator with the standard lab password.
 - d. Set the ESXi host as the target server.

```
vifptarget -s server
```

Replace *server* with the ESXi FQDN.

The server targets that you configured in the previous lab are still defined.

3. Display the manual page for *resxtop*.

```
man resxtop
```

Press the Enter key to scroll down one line at a time to familiarize yourself with the contents of the manual page. The manual page gives a brief description of the counters that appear on the different screens. You can also press the space bar to scroll down one screen at a time.

4. Type **Q** to return to the vSphere Management Assistant command prompt.
5. Maximize the PuTTY (vSphere Management Assistant session) window.
6. Start *resxtop*.

```
resxtop
```

Task 6: Explore *resxtop* Output

The *esxtop* and *resxtop* output can be adjusted to show performance statistics for various classes of objects and types of counters.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Your student designation
1. To display the disk adapter screen, type **d**.

By default, 12 columns are displayed:

- ADAPTER
- PATH
- NPTH

- CMDS/s
 - READS/s
 - WRITES/s
 - MBREAD/s
 - MBWRTN/s
 - DAVG/cmd
 - KAVG/cmd
 - GAVG/cmd
 - QAVG/cmd
2. Add the QSTATS field to the disk adapter output.
 - a. To view the Current Field Order list, type **f**.
 - b. In the Current Field Order list, type **D** to select the QSTATS field.
 An asterisk appears next to the **D: QSTATS** field selection, indicating that the QSTATS field is included in the `resxtop` output.
 - c. Press the Enter key to return to the statistics display, and verify that the AQLLEN column appears in the output, to the right of NPTH.
 3. Remove the PATH and NPTH fields from the disk adapter output.
 - a. To view the Current Field Order list, type **f**.
 - b. In the Current Field Order list, type **B** and **C** to remove the asterisk from the PATH and NPTH fields.
 - c. Press Enter to return to the statistics display and verify that eleven columns appear in the output.
 4. To display the CPU statistics screen, type **c**.
 5. To filter the output so that only virtual machines are listed, type uppercase **v**.

6. Expand the Linux01 virtual machine container.
 - a. To display the group expand/rollup prompt, type **e**.
The prompt appears above the output table.
 - b. At the expand/rollup prompt, type the GID of the Linux01 virtual machine, and press Enter.
 - c. The GID appears to the left of the virtual machine name in the statistics table.

```
PCPU USED(%): 17 3.4 AVG: 10
PCPU UTIL(%): 19 3.7 AVG: 11
Group to expand/rollup (gid): 64464


| ID    | GID   | NAME    | NWLD |
|-------|-------|---------|------|
| 64464 | 64464 | Linux01 | 7    |


```

The Linux01 group is expanded so that the child objects are displayed.

7. Remove all fields other than ID, GID, and NAME.
 - a. To view the Current Field Order list, type **f**.
 - b. For each field with an asterisk, other than ID, GID, and NAME, type the corresponding letter to remove the asterisk.
 - c. Press Enter to return to the CPU screen and verify that only the ID, GID, and NAME fields are displayed.
8. To save the current `resxtop` configuration, type **w**.
9. When prompted, type `student_username.config` for filename, and press Enter.
Replace `student_username` with your student designation. For example, if your student login name is StudentA, then save the output configuration as `StudentA.config`.
The `/home/vi-admin` path specification is optional. If you do not specify a path, the file is saved to the vi-admin home folder, by default.
10. Press Ctrl-C, or type **q**, to exit `resxtop`.
11. Start `resxtop` using the saved configuration file.

```
resxtop -c designation.config
```


Replace `designation` with your student designation.
12. In the `resxtop` output, verify that CPU statistics is the current output and that only three columns appear.
13. Press Ctrl-C, or type **q**, to exit `resxtop`.

Task 7: Run `resxtop` in Batch Mode

The `esxtop` and `resxtop` commands can be run in batch mode. Batch mode is useful for capturing data that is to be imported and analyzed by other tools, such as Windows Performance Monitor (PerfMon).

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Your student designation

1. Start `resxtop` in batch mode.

```
resxtop -b -a -n 24 > designation.csv
```

Replace *designation* with your student designation. For example, if your student designation is StudentA, then you specify an output file as `StudentA.csv`.

`resxtop` runs in batch mode to capture and record 2 minutes of data by taking 24 samples at a default sampling rate of 5 seconds.

2. Wait for the `resxtop` command to complete.

Task 8: Use Windows Performance Monitor to Display Captured Statistics

The CSV output of `esxtop` or `resxtop` can be easily imported by other tools for analysis.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Your student designation

1. Minimize the PuTTY (vSphere Management Assistant session) window.
2. Copy the captured CSV file to the Control Center desktop using WinSCP.

- a. On the Control Center desktop, double-click the **WinSCP** icon.

- b. In the WinSCP window, double-click the **vSphere Management Assistant** session.

You are automatically logged in.

- c. In the right pane, locate the *designation.csv* file that you saved in the previous task.

Replace *designation* with your student designation. For example, if your student designation is StudentA, then specify an output file as `StudentA.csv`.

- d. Drag the *designation.csv* file to the Control Center desktop.
 - e. When prompted, click **Copy**.
 - f. When the copy operation completes, close the WinSCP window.
 - g. When prompted, click **OK** to close WinSCP.
3. On the Control Center desktop, start Windows Performance Monitor by double-clicking the **Performance** shortcut.
 4. In the Performance window, right-click anywhere in the graph pane and select **Properties**.
 5. Add the CSV data source.
 - a. In the System Monitor Properties window, click the **Source** tab.
 - b. Click the **Log files** radio button and click **Add**.
 - c. Navigate to the desktop and open the CSV file.
Do not click OK after loading the CSV.
 6. Configure data counters.
 - a. In the System Monitor Properties window, click the **Data** tab.
The window might appear to freeze as the Performance Monitor parses the CSV file.
 - b. In the Counters panel, press Shift+Click to select all counters and click **Remove**.
 - c. Click **Add**.
 - d. Above Select instances from list, select the **All instances** radio button, on the right side of the window.
 - e. In the Add Counters dialog box, select **Vcpu** from the **Performance object** pull-down menu.
 - f. Under Select counters from list, press Ctrl+Click to select **%Ready** and **%Used** and click **Add**.
The **%CoStop** counter is selected by default. Click the first value to deselect the **%CoStop** counter.
 - g. Click **Close**.
 - h. In the Counters panel, verify that the **%Ready** and **%Used** counters appear.
 7. Click **OK**.

8. Monitor the performance window output.

Q1. After the graph refreshes, does the graph continue to update?

Q2. Why is the graph not updated?

9. Close the Performance window.

Task 9: Clean Up for the Next Lab

Perform the following steps to prepare for the next lab.

Student A and student B should do this task independently.

1. Restore the minimized Firefox window and click the **Linux01** console tab.
2. In the Linux01 console, select the terminal window and press Ctrl+C to stop the test script
Leave the terminal window open for the next lab.
3. In the Firefox window, leave the vSphere Web Client and Linux01 console tabs open for the next lab.
4. Leave the PuTTY (vSphere Management Assistant session) window open and minimized for use in upcoming labs.

Lab 3

VMware vSphere Distributed Switches

Objective: Create and configure a distributed switch

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Power On a Virtual Machine and Test Network Connectivity
3. Create a Distributed Switch
4. Examine the Distributed Switch Configuration
5. Migrate the Virtual Machines to a Distributed Switch Port Group
6. Verify Network Connectivity
7. Complete the Network Migration
8. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client if it is not already open and power on the virtual machine.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Open the vSphere Web Client interface if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.
 - d. In the left pane, select **vCenter > Hosts and Clusters**.
 2. If the Linux01 virtual machine is not powered on, go to the Hosts and Clusters inventory tree, select the **Linux01** virtual machine, and select **Power On** from the **Actions** drop-down menu.
 3. In the Firefox window, open the **Linux01** console tab if the tab is closed.
 - a. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Open Console** from the **Actions** drop-down menu.
 - b. If prompted to log in, log in as root with the standard lab password.

Task 2: Power On a Virtual Machine and Test Network Connectivity

You power on virtual machines attached to the VM Network standard switch and verify IP parameters and connectivity.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
1. Power on the Win01 virtual machine, open a console window, and log in.
 - a. In the Firefox window, click the **vSphere Web Client** tab.
 - b. In the Hosts and Clusters inventory tree, select the **Win01** virtual machine and select **Power On** from the **Actions** drop-down menu.
 - c. Wait for the power operation to complete and select **Open Console** from the **Actions** drop-down menu.

- d. When prompted to log in, click the **Send Ctrl-Alt-Del** button located in the upper-right corner of the console window.
 - e. Log in as administrator with the standard lab password.
2. Examine the Win01 IP configuration.
 - a. On the virtual machine desktop, double-click the **Command Prompt** shortcut.
 - b. In the command prompt window, examine the virtual machine IP configuration.

```
ipconfig
```

The virtual machine has an IP address in the management network range, such as 172.20.10.200. The virtual machine is connected to the default VM Network standard switch, which has connectivity with the management network. The Win01 virtual machine is receiving a Dynamic Host Configuration Protocol (DHCP) assignment from the domain controller at 172.20.10.5.

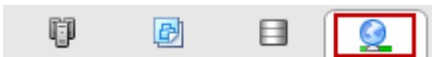
3. In the Firefox window, click the **vSphere Web Client** tab.
Leave the Win01 virtual machine console tab open.

Task 3: Create a Distributed Switch

One vSphere distributed switch is already configured in your VMware® vCenter Server™ inventory. The existing distributed switch has the uplinks and port groups necessary to carry VMware vSphere® vMotion® and IPStorage traffic for the sandbox infrastructure. See the class network diagram for more information on how these connections are configured. You create a second distributed switch on which a Production network for virtual machines can be established.

Student A and student B should do this task independently.

1. In the left pane, click the **Networking** icon.



2. Create a distributed switch in the Training data center.
 - a. Expand the Networking inventory tree and select the **Training** data center
 - b. Select **New Distributed Switch** from the **Actions** drop-down menu.
 - c. In the New Distributed Switch dialog box, type **dvs - Lab** in the **Name** text box and click **Next**.
 - d. Under Select version, leave **Distributed switch 5.5.0** selected and click **Next**.

- e. Under Edit Settings, edit the distributed switch settings.

Option	Action
Number of uplinks	Type 1 .
Network I/O Control	Leave Enabled selected.
Default port group	Leave the check box selected.
Port group name	Type pg-Production in the text box.

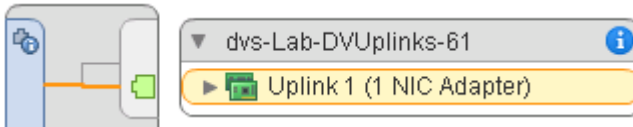
- f. Click **Next**.
 - g. Under Ready to complete, review the configuration settings and click **Finish**.
3. Add the VMware® ESXi™ host to the new distributed switch.
 - a. In the Networking inventory tree, expand the **Training** data center object.
 - b. Select the **dvs-Lab** distributed switch and select **Add and Manage Hosts** from the **Actions** drop-down menu.
 - c. In the Add and Manage Hosts dialog box, leave **Add hosts** selected and click **Next**.
 - d. Under Select hosts, click the **New hosts** link, select the **ESXi host** check box, and click **OK**.
 - e. Click **Next**.
 - f. Under Select network adapter tasks, deselect the **Manage VMkernel adapters** check box and click **Next**.
 - g. Under Manage physical network adapters, select **vmnic3** and click the **Assign uplink** link.
 - h. Select **Uplink 1** and click **OK**.
 - i. Click **Next**.
 - j. Under Analyze impact, click **Next**.
 - k. Under Ready to complete, click **Finish**.

Task 4: Examine the Distributed Switch Configuration

Distributed switch uplinks are bound to physical interfaces on the ESXi hosts added to the distributed switch configuration. Additionally, you can configure other distributed switch features, including maximum transmission unit (MTU) value, VLAN capabilities, LACP aggregation groups, NetFlow and Network I/O Control.

Student A and student B should do this task independently.

1. In the Networking inventory tree, expand the **dvs-Lab** distributed switch.
2. In the middle pane, click the **Manage** tab and click the **Settings** button.
3. Click the **Topology** link.
4. In the distributed switch topology diagram, expand **Uplink 1** and verify that the ESXi host vmnic3 interface is attached.



5. In the middle pane, on the left, click the **Properties** link and verify the settings.
 - Network I/O Control is enabled.
 - DirectPath I/O is supported.
 - The MTU size is 1500 bytes.
 - The Cisco Discovery Protocol is implemented.
6. Click each additional configuration link and verify the following settings.
 - No LACP LAGs are defined.
 - No private VLANs are defined.
 - A NetFlow collector is not defined.
 - Port mirroring is not configured.
 - Health checks are not enabled.
7. In the Networking inventory tree, select the **pg-Production** port group.
8. In the middle pane, click the **Manage** tab and click the **Settings** button.
9. Click the **Properties** link and verify the settings.
 - Static port binding is implemented.
 - Elastic port allocation is implemented.
 - Eight ports are defined.

Task 5: Migrate the Virtual Machines to a Distributed Switch Port Group

You move a subset of your virtual machines to the production port group.

Student A and student B should do this task independently.

1. In the Networking inventory tree, select the **dvs-Lab** distributed switch and select **Migrate VM to Another Network** from the **Actions** drop-down menu.
2. In the Migrate Virtual Machine Networking dialog box, migrate the virtual machines.
 - a. For the Source network, leave the **Specific network** radio button selected, click the **Browse** button, select **VM Network**, and click **OK**.
 - b. For the Destination network, click the **Browse** button, select the **pg-Production** portgroup, and click **OK**.
 - c. Click **Next**.
 - d. Under Select virtual machines to migrate, select the check box to migrate the virtual machines.
 - Linux01
 - Win01
 - Win02Do not migrate the Linux02 virtual machine.
 - e. Click **Next**.
 - f. Under Ready to complete, click **Finish**.
 - g. In the Recent Tasks pane, monitor the status of the migration task to completion.
3. In the middle pane, click the **Summary** tab.
4. Find the Switch Details panel and verify the settings.
 - Two networks are defined.
 - One host is attached.
 - Three virtual machines are attached.

Task 6: Verify Network Connectivity

When virtual machines are migrated to a different virtual network, certain administration tasks must be performed. These tasks ensure that the machine is configured properly to operate on the new segment. The appropriate network services must also be available to the new segment for the successful migration of virtual machines. In the lab environment, access to DHCP and DNS services from your production network is already configured. See the lab networking diagram.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Production network DHCP range

1. In the Firefox window, select the **Win01** console tab.
2. In the Win01 console, click the Command Prompt window.
3. To acquire a new DHCP-assigned IP address, verify that the virtual machine has acquired a new IP address in your production network DHCP range.

```
ipconfig /release
```

```
ipconfig /renew
```

4. In the `ipconfig` output, find the default gateway address.
5. Test local network connectivity by pinging the production network gateway address.

```
ping gateway_address
```

Replace `gateway_address` with the default gateway address reported by the `ipconfig` command.

The ping command receives responses from the gateway. The responses indicate that the production port group has connectivity to the physical network through the distributed switch uplink that is associated with `vmnic3` on the ESXi host. See the lab network diagrams in the lab configuration handout to review the network topology as needed.

6. Test Internet connectivity and DNS resolution.

```
ping www.vmware.com
```

The ping command receives responses from the `http://www.vmware.com` Web site, indicating that the infrastructure network is configured to properly route virtual machine traffic.

7. Close the Command Prompt window.

Task 7: Complete the Network Migration

Update the remaining hosts that were migrated while running.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Production network DHCP range

1. In the Firefox window, select the **Linux01** console tab.
2. If a terminal window is not open on the Linux01 desktop, right-click the desktop and select **Open Terminal**.

3. In the terminal window, acquire a new DHCP-assigned IP address.

```
dhclient
```

4. After the `dhclient` command completes, examine the output.

The last message must be similar to this message.

```
bound to 172.20.xxx.yyy -- renewal in ##### seconds
```

5. Verify that the bound IP address is in your production DHCP range.

The Win02 virtual machine does not run during the migration. The new segment configuration is picked up when the virtual machine starts and acquires a DHCP lease.

Task 8: Clean Up for the Next Lab

Perform the following steps to prepare for the next lab.

Student A and student B should do this task independently.

1. In the Firefox window, leave the **vSphere Web Client**, **Linux01**, and **Win01** tabs open for the next lab.

Lab 4

Port Mirroring

Objective: Configure and use port mirroring to capture network traffic

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Back Up the Distributed Switch Configuration
3. Prepare to Capture Mirrored Network Traffic
4. Configure Port Mirroring on the Distributed Switch
5. Capture Traffic Using Port Mirroring
6. Restore the Distributed Switch Configuration
7. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client if it is not already open and power on the virtual machines.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Open the vSphere Web Client interface if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.
 - d. In the left pane, click **vCenter** and click **Networking**.
 2. If the Win01 virtual machine is not powered on, go to the Hosts and Clusters inventory tree, select the **Win01** virtual machine, and select **Power On** from the **Actions** drop-down menu.
 3. In the Firefox window, open the **Win01** console tab if it is closed.
 - a. In the Hosts and Clusters inventory tree, select the **Win01** virtual machine and select **Open Console** from the **Actions** drop-down menu.
 - b. If prompted to log in, log in as administrator with the standard lab password.
 4. If the Linux01 virtual machine is not powered on, go to the Hosts and Clusters inventory tree, select the **Linux01** virtual machine, and select **Power On** from the **Actions** drop-down menu.
 5. In the Firefox window, open the **Linux01** console tab if it is closed.
 - a. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Open Console** from the **Actions** drop-down menu.
 - b. If prompted to log in, log in as root with the standard lab password.

Task 2: Back Up the Distributed Switch Configuration

You save a backup of the dvs-Lab vSphere distributed switch configuration.

Student A and student B should do this task independently.

1. In the Firefox window, click the **vSphere Web Client** tab.
2. In the Networking inventory tree, select the **dvs-Lab** distributed switch and select **All vCenter Actions > Export Configuration** from the **Actions** drop-down menu.
3. In the Export Configuration dialog box, leave the **Distributed switch and all port groups** radio button selected and click **OK**.
4. When prompted, click **Yes** to save the exported configuration.
5. Save the distributed switch configuration to the Control Center desktop, using the default `backup.zip` file.

Task 3: Prepare to Capture Mirrored Network Traffic

The Linux01 virtual machine monitors the mirrored traffic.

Student A and student B should do this task independently.

1. In the Firefox window, click the **Linux01** console tab.
2. If a terminal window is not open on the Linux01 desktop, right-click the desktop and select **Open Terminal**.
3. In the terminal window, monitor the HTTP network traffic.

```
tcpdump -nn port 80
```

```
[root@localhost ~]# tcpdump port 80
tcpdump: verbose output suppressed, use -v or -vv for full protocol decode
listening on eth0, link-type EN10MB (Ethernet), capture size 96 bytes
```

4. Monitor the command output for a few seconds and verify that HTTP traffic is not being captured.

`tcpdump` output remains silent until HTTP traffic is detected on the network.

5. Leave the terminal window open, with the `tcpdump` command running uninterrupted.
6. In the Firefox window, click the **vSphere Web Client** tab and click the **Hosts and Clusters** icon in the left pane.
7. In the Firefox window, click the **Win01** console tab.

The Win01 virtual machine is used as the traffic source to be monitored.

8. Wait for the Web page to load and click the **Linux01** console tab.
9. In the terminal window, verify that the running `tcpdump` command is the same as before and has not captured any HTTP (port 80) traffic.

Task 4: Configure Port Mirroring on the Distributed Switch

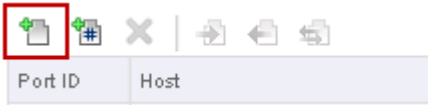
Port mirroring is configured so that the port connected to the Win01 machine is the mirror source and the port connected to the Linux01 machine is the mirror destination. All the traffic present on the Win01 port is forwarded to the Linux01 port for examination.

Student A and student B should do this task independently.

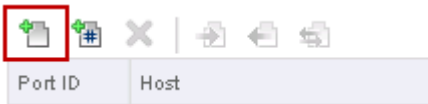
1. In the Firefox window, click the **vSphere Web Client** tab.
2. In the left pane, click the **Networking** icon.
3. In the Networking inventory tree, select the **dvs-Lab** distributed switch.
4. In the middle pane, click the **Manage** tab and click the **Settings** button.
5. Click the **Port mirroring** link.
6. In the Port mirroring panel, click the **New** link.
7. In the Add Port Mirroring Session dialog box, leave the **Distributed Port Mirroring** radio button selected and click **Next**.
8. Under Edit properties, configure the session details.

Option	Action
Name	Leave as Session 0 .
Status	Select Enabled from the drop-down menu.
Normal I/O on destination ports	Select Allowed from the drop-down menu.
Mirrored packet length (Bytes)	Leave the check box deselected.
Sampling rate	Leave at 1 .
Description	Leave blank.

9. Click **Next**.
10. Under Select sources, click the **Select distributed ports** icon.



11. In the Select Ports dialog box, select the check box for the row with a connected entity of **Win01** and click **OK**.
12. Click **Next**.
13. Under Select destinations, click the **Select distributed ports** icon.



14. In the Select Ports dialog box, select the check box for the row with a connected entity of **Linux01** and click **OK**.
15. Click **Next**.
16. Under Ready to complete, review settings and click **Finish**.

Task 5: Capture Traffic Using Port Mirroring

With mirroring between ports configured, any HTTP traffic appearing on the Win01 port is duplicated on the Linux01 port for capture by the running `tcpdump` command.

Student A and student B should do this task independently.

1. In the Firefox window, click the **Win01** console tab.
2. In the Internet Explorer window, refresh the page, or go to <http://www.google.com>.
The Google Web site is used because it is simple, loads quickly, and is publicly accessible.
3. Wait for the Web page to appear and click the **Linux01** console tab.

4. In the Linux01 console, examine the `tcpdump` output in the terminal window.

The output looks similar to the following example. The production network address is different for student A and student B. The example uses the student A production network.

```
16:29:40.992888 IP 205.251.215.86.80 > 172.20.11.101.1094:  
16:29:40.992918 IP 172.20.11.101.1094 > 205.251.215.86.80:  
16:29:40.992948 IP 172.20.11.101.1094 > 205.251.215.86.80:  
16:29:41.243262 IP 174.129.48.152.80 > 172.20.11.101.1095:
```

In this example, the local IP address involved in the HTTP exchange is in the Dynamic Host Configuration Protocol (DHCP) range for student A's production network (172.20.11.100 through 172.20.11.199). Student B observes a local address in the DHCP range of 172.20.110.100 through 172.20.110.199.

5. Record the local address that appears in the captured traffic. _____

The local address begins with 172.20.

6. In the terminal window, press Ctrl+C to stop the `tcpdump` command.
7. In the Firefox window, click the **Win01** console tab.
8. In the Win01 console, close the Internet Explorer window.
9. On the Win01 desktop, double-click the **Command Prompt** shortcut and examine the **Win01** IP configuration.

```
ipconfig /all
```

10. Using the command output, verify that the Win01 IP address matches the address that you recorded in step 5.
11. Close the Command Prompt window.

Task 6: Restore the Distributed Switch Configuration

Restoring the distributed switch configuration resets any configuration change made since the configuration was saved. For this lab, changes made to the port mirroring configuration are discarded and port mirroring is disabled.

Student A and student B should do this task independently.

1. In the Firefox window, click the **vSphere Web Client** tab.
2. In the Networking inventory tree, select the **dvs-Lab** distributed switch and verify that the port mirroring session list appears in the middle pane.
3. Select **All vCenter Actions > Restore Configuration** from the **Actions** drop-down menu.
4. In the Restore Configuration dialog box, click the **Browse** button, select the `backup.zip` file, and click **Open**.
5. Leave the **Restore distributed switch and all port groups** radio button selected and click **Next**.
6. Under Ready to complete, review the settings and click **Finish**.
7. After the switch configuration has been restored, verify that the port mirroring session list is empty.

Task 7: Clean Up for the Next Lab

Perform the following actions to prepare for the next lab.

Student A and student B should do this task independently.

1. In the Firefox window, leave the **vSphere Web Client** and **Linux01** tabs open for the next lab, and close the **Win01** console tab.

Lab 5

Monitoring Network Performance

Objective: Use resxtop to monitor network performance

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Prepare to Monitor Network Performance
3. Prepare the Client and Server Virtual Machines
4. Measure Network Activity on an ESXi Physical Network Interface
5. Use Traffic Shaping to Simulate Network Congestion
6. Position the Client and Server on the Same Port Group
7. Restart the Test and Measure Network Activity
8. Stop the Test and Analyze Results
9. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You log in to VMware vSphere® Management Assistant, open the VMware vSphere® Web Client, and power on the virtual machine.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - vSphere Management Assistant administrator user name
 - Standard lab password
 - ESXi FQDN
1. If the PuTTY window is closed, log in to the vSphere Management Assistant and set the VMware® ESXi™ host as the target server.
 - a. On the Control Center desktop, double-click the **PuTTY** shortcut.
 - b. In the PuTTY window, double-click the **vSphere Management Assistant** session.
 - c. Log in as the vSphere Management Assistant administrator with the standard lab password.
 - d. Set the ESXi host as the target server.

```
vifptarget -s server
```

Replace *server* with the ESXi fully qualified domain name (FQDN).
 2. Open the vSphere Web Client interface if it is not open.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.
 3. If the Linux01 virtual machine is not powered on, in the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Power On** from the **Actions** drop-down menu.
 4. In the Firefox window, open the **Linux01** console tab if it is closed.
 - a. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Open Console** from the **Actions** drop-down menu.
 - b. If prompted to log in, log in as root with the standard lab password.
 5. In the left pane, click **vCenter** and click **Networking**.

Task 2: Prepare to Monitor Network Performance

The `resxtop` network statistics screen is used to monitor network performance.

Student A and student B should do this task independently.

1. Maximize the PuTTY (vSphere Management Assistant session) window.

2. Start `resxtop`.

```
resxtop
```

3. To switch to the network statistics screen, type **n**.
4. Change the update delay from the default 5 seconds to 10 seconds
 - a. Type **s**.
 - b. Type **10**.
 - c. Press Enter.

5. Remove unused counters to make the `resxtop` network screen easier to monitor.

You monitor the MbTX/s and MbRX/s counters in upcoming tasks. Removing counters that are not monitored during the test can make isolation of the MbTX/s and MbRX/s values easier.

- a. To show the Current Field Order table, press F.
- b. In the Current Field Order table, to remove PKTRX/s and PKTTX/s, press the corresponding keys and remove the asterisks.
- c. Press Enter to return to the network statistics screen.

Task 3: Prepare the Client and Server Virtual Machines

Scripts on the Linux01 and Linux02 virtual machines are used to generate network traffic so that network performance can be measured. The Linux01 machine acts as a client and the Linux02 machine acts as a server.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
 - Production network DHCP range
1. Restore the Firefox window and click the **Linux01** tab.
 2. Record the client eth0 IP address.
 - a. In the Linux01 console, if a terminal window is not open on the desktop, right-click the desktop and select **Open Terminal**.

- b. In the terminal window, view the eth0 IP configuration.

```
ifconfig
```

```
Link encap:Ethernet HWaddr 00:50:56:BC:20:88  
inet addr:172.20.11.102 Bcast:172.20.11.255
```

- c. Record the Linux01 eth0 inet address. _____

The Linux01 eth0 inet address must be within your production network Dynamic Host Configuration Protocol (DHCP) range.

3. Power on the Linux02 virtual machine and open a console to the virtual machine desktop.
 - a. In the Firefox window, click the **vSphere Web Client** tab.
 - b. In the left pane, click the **Hosts and Clusters** icon.
 - c. In the Hosts and Clusters inventory tree, select the **Linux02** virtual machine and select **Power On** from the **Actions** drop-down menu.
 - d. In the recent tasks pane, monitor the power on operation to completion and select **Open Console** from the **Actions** drop-down menu.
 - e. Log in as root with the standard lab password.
4. Record the server eth0 IP address.
 - a. In the Linux02 console, right-click the desktop and select **Open Terminal**.
 - b. In the terminal window, restart the network service.

```
service network restart
```

IMPORTANT

Restart the network service to ensure that IP routing information is up to date and that the service is functioning properly,

- c. After the network service has restarted, view the eth0 IP configuration.

```
ifconfig
```

- d. Record the Linux02 eth0 inet address. _____

The Linux02 eth0 inet address must be in the management network range 172.20.10.0 through 172.20.10.24.

Initially the Linux01 (client) and Linux02 (server) machines are positioned on different network segments, across a router.

5. Start the server.
 - a. In the terminal window, navigate to the network scripts folder.

```
cd netperf
```

- b. Start the server program.

```
./netserver
```

```
Starting netserver at port 12865
Starting netserver at hostname 0.0.0.0 port 12865
```

The server program runs as a background process.

- c. Verify that the server program is running.

```
ps -ef | grep netserver
```

The server and grep processes are listed

```
00:00:00 ./netserver
00:00:00 grep netserver
```

5

Task 4: Measure Network Activity on an ESXi Physical Network Interface

The Linux01 and Linux02 virtual machines are positioned on different physical network segments across a router. Because of this positioning, you can measure the actual network performance of the ESXi host network interface. Requests sent from the Linux01 client enter the physical network through the ESXi network interface vmnic3 that is bound to a dvs-Lab distributed switch uplink. The client requests are routed to the management network where the Linux02 server is positioned using the VM Network standard switch.

Student A and student B should do this task independently.

1. In the Firefox window, click the **Linux01** console tab.
2. Start the client.
 - a. In the terminal window, navigate to the network scripts folder.

```
cd netperf
```

- b. Start the client test script.

```
./nptest1.sh server
```

Replace *server* with the Linux02 eth0 inet address that you recorded in the preceding task.

```
[root@linux01 netperf]# ./nptest1.sh 172.20.11.102

===> This script runs for 60 minutes before exiting.
t it unless instructed to do so.

TCP STREAM TEST from 0.0.0.0 (0.0.0.0) port 0 AF_INET
20.11.102) port 0 AF_INET
```

The client and server programs must run uninterrupted.

3. Monitor network activity and record your findings.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. In the *resxtop* output, find the *vmnic3* physical network interface.

```
67108866          vmnic3
67108867          Shadow of vmnic3
67108868          42832:Win01.eth0
67108869          43087:Linux01.eth0
```

- c. Record the *vmnic3* values for the separate *resxtop* updates in the 100Mb/s test row of the samples table.
 - MbTX/s _____
 - MbRX/s _____

Task 5: Use Traffic Shaping to Simulate Network Congestion

The traffic shaping feature available on distributed switch port groups allows administrative control of network throughput at the port group level. With traffic shaping, the network speed can be controlled to simulate congestion, to simulate conditions present if the ESXi hosts are moved to another location, or to control consumption of production bandwidth.

Student A and student B should do this task independently.

1. Switch to the Firefox window and click the **vSphere Web Client** tab.
2. In the inventory tree, click the **Networking** icon.

3. In the networking inventory, expand the **dvs-Lab** distributed switch and select the **pg-Production** port group.
4. In the middle pane, click the **Manage** tab and click the **Settings** button.
5. Select the **Properties** link and click the **Edit** button.
6. In the Edit Settings dialog box, select the **Traffic shaping** link.
7. Configure Ingress and Egress traffic shaping, using the configuration options.

Option	Action
Status	Select Enabled form the drop-down menu.
Average bandwidth (kbit/s)	Type 10000 in the text box.
Peak bandwidth (kbits/s)	Type 10000 in the text box.
Burst size (KB)	Type 10000 in the text box.

8. Click **OK** to close the Edit Settings dialog box.
9. Monitor network performance and record your findings.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. In the `resxtop` output, find the `vmnic3` physical interface item.
 - c. Record the `vmnic3` values for the separate `resxtop` updates in the 10Mb/s test row of the samples table.
 - MbTX/s _____
 - MbRX/s _____
10. Switch to the Firefox window.
11. In the middle pane, click the **Edit** button to configure traffic shaping a second time.
12. In the Edit Settings dialog box, select the **Traffic shaping** link.

13. Configure Ingress and Egress traffic shaping, using the configuration options.

Option	Action
Status	Select Enabled form the drop-down menu.
Average bandwidth (kbit/s)	Type 1000 in the text box.
Peak bandwidth (kbits/s)	Type 1000 in the text box.
Burst size (KB)	Type 1000 in the text box.

14. Click **OK** to close the Edit Settings dialog box.
15. Monitor network activity and record your findings.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. In the `resxtop` output, find the `vmnic3` physical interface item.
 - c. Record the `vmnic3` values for the separate `resxtop` updates in the 1Mb/s test row of the samples table.
 - MbTX/s _____
 - MbRX/s _____
16. Switch to the Firefox window.
17. In the middle panel, click the **Edit** button to configure traffic shaping.
18. In the Edit Settings dialog box, select the **Traffic shaping** link.
19. For both Ingress and Egress traffic shaping, select **Disabled** from each **Status** drop-down menu.
20. Click **OK** to close the Edit Settings dialog box.

Task 6: Position the Client and Server on the Same Port Group

Virtual machines communicating on the same ESXi host and virtual switch port group can communicate at a faster rate than dictated by the physical network hardware.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Production network DHCP range

1. Stop the client.
 - a. In the Firefox window, click the **Linux01** console tab.

- b. In the Linux01 console, select the terminal window and press Ctrl+C to stop the test script.
2. Stop the server.

- a. In the Firefox window, click the **Linux02** console tab.
- b. In the Linux02 console, select the terminal window and end the server program.

```
ps -ef | grep netserver  
  
kill process_id
```

In the `kill` command, replace `process_id` with the netserver process id as reported by the `ps` command. In the example `ps` output, the netserver process ID is 6487.

```
6487      1  0 09:55 ?        00:00:00 ./netserver  
7629    6303  2 10:41 pts/1    00:00:00 grep netserver
```

The image shown does not include the leftmost columns of the PS output.

3. Migrate the Linux02 virtual machine to the production network.
 - a. In the Firefox window, select the **vSphere Web Client** tab.
 - b. In the Networking inventory tree, select the **dvs-Lab** distributed switch and select **Migrate VM to Another Network** from the **Actions** drop-down menu.
 - c. For the Source network, leave the **Specific network** radio button selected, click the **Browse** button, select **VM Network**, and click **OK**.
 - d. For the Destination network, click the **Browse** button, select the **pg-Production** port group, and click **OK**.
 - e. Click **Next**.
 - f. Under Select virtual machines to migrate, select the **Linux02** check box and click **Next**.
 - g. Click **Finish**.
 - h. In the Recent Tasks pane, monitor the migration task to completion.
4. In the Firefox window, click the **Linux02** console tab.
5. Restart the network service and verify that the DHCP-assigned IP address for eth0 is within your production DHCP range.
 - a. In the terminal window, restart the network service.

```
service network restart
```

It might take up to a minute for the network service to restart and acquire a new DHCP address.

- b. Verify that a new DHCP-assigned address has been acquired.

```
ifconfig
```

- c. In the `ifconfig` command output, verify that the `eth0` inet addr is in your production network DHCP range.
- d. Record the Linux02 postmigration `eth0` inet address. _____

Task 7: Restart the Test and Measure Network Activity

The client and server communicate across a virtual network contained within a single ESXi host and port group.

Student A and student B should do this task independently.

1. In the Linux02 terminal window, start the server program.

```
./netserver
```

2. In the Firefox window, click the **Linux01** console tab.
3. In the terminal window, start the client script.

```
./nptest1.sh server
```

Replace *server* with the postmigration Linux02 IP address that you recorded in the preceding task.

4. Monitor network activity and record your findings.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. In the `resxtop` output, find the `vmnic3` row and verify that the traffic is no longer traversing the physical interface.
 - c. Find the Linux01.`eth0` row.

```
42832:Win01.eth0      vmnic3
43087:Linux01.eth0   vmnic3
1322548:Linux02.eth0  vmnic3
```

- d. Record the `vmnic3` values for the separate `resxtop` updates in the Same Portgroup row of the samples table.
 - MbTX/s _____
 - MbRX/s _____
5. Press `Ctrl+C` or `Q` to stop `resxtop`.

Task 8: Stop the Test and Analyze Results

Use samples that you recorded to determine if network performance was affected by the simulated congestion in an expected manner, and to determine the fastest network configuration.

Student A and student B should do this task independently.

1. Stop the test.
 - a. Switch to the Firefox window.
 - b. In the Linux01 console, select the terminal window and press Ctrl+C to stop the client script.
 - c. In the Firefox window, click the **Linux02** console tab,.
 - d. In the Linux02 console, select the terminal window and end the server program.

```
ps -ef | grep netserver
```

```
kill process_id
```

Replace *process_id* with the netserver process ID that is displayed in the `ps` command output.

2. Review the sample values recorded and answer the questions.

Q1. Is there an obvious difference in network throughput for each test?

Q2. Which test resulted in the highest throughput (highest values)?

Q3. Why was this test the fastest?

Task 9: Clean Up for the Next Lab

Perform the following actions to prepare for the next lab.

Student A and student B should do this task independently.

1. In the Firefox window, leave the **vSphere Web Client** and **Linux01** tabs open for the next lab, and close the **Linux02** console tab.
2. Leave the PuTTY (vSphere Management Assistant session) window open and minimized for the next lab.

Lab 6

Command-Line Network Management

Objective: Use command-line tools to manage networking

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Use ESXCLI and vicfg Commands to Examine Physical and Virtual Network Settings
3. Use the grep Command to Examine VMX Network Settings
4. Examine net-dvs Output
5. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You open the PuTTY (VMware vSphere® Management Assistant session) window if it is closed.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere Management Assistant administrator user name
- Standard lab password
- ESXi FQDN

1. Minimize the Firefox window.
2. Restore the PuTTY (vSphere Management Assistant session) window that was minimized at the end of the previous lab.
3. If the PuTTY window is closed, log in to the vSphere Management Assistant and set the VMware® ESXi™ host as the target server.
 - a. On the Control Center desktop, double-click the **PuTTY** shortcut.
 - b. In the PuTTY window, double-click the **vSphere Management Assistant** session.
 - c. Log in as the vSphere Management Assistant administrator with the standard lab password.
 - d. Set the ESXi host as the target server.

```
vifptarget -s server
```

Replace *server* with the ESXi fully qualified domain name (FQDN).

Task 2: Use ESXCLI and vicfg Commands to Examine Physical and Virtual Network Settings

The ESXCLI and `vicfg` commands can be used to examine physical and virtual networking configurations in detail.

Student A and student B should do this task independently.

1. Maximize the PuTTY (vSphere Management Assistant session) window.
2. List each physical network interface.

```
esxcli network nic list
```

3. List each standard switch and the switch properties.

```
esxcli network vswitch standard list
```


4. Use the command output to verify the configuration settings.
 - A single standard switch is defined.
 - The standard switch uplink uses the vmnic0 physical interface.
 - The maximum transmission unit is 1500.
 - The VM Network port group is defined.
5. List each distributed switch and the switch properties.
`esxcli network vswitch dvs vmware list`
6. Use the command output to verify the configuration settings.
 - Two distributed switches are defined.
 - The dvs-Infrastructure switch is configured with two uplinks.
7. List all IPv4 VMkernel interfaces.
`esxcli network ip interface ipv4 get`
8. Use the command output to verify that each VMkernel interface has a static IPv4 address, an IPv4 netmask, and an IPv4 broadcast address configured.
9. Determine if IPv6 is enabled for each VMkernel interface.
`esxcli network ip interface ipv6 get`
10. List each VMkernel interface and the interface properties.
`esxcli network ip interface list`
11. View information about all virtual switches.
`vicfg-vswitch -l`
12. Use the command output to verify the configuration settings.
 - The management network is located on vSwitch0 and uses the vmnic0 uplink.
 - VMkernel adapters are not defined on the dvs-Lab distributed switch.
 - Two VMkernel adapters are defined on the dvs-Infrastructure distributed switch.
13. Minimize the PuTTY (vSphere Management Assistant session) and Firefox windows.

Task 3: Use the grep Command to Examine VMX Network Settings

After a VMX file location has been determined, the `grep` command can be used to query the VMX settings based on query patterns.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
 - VMX folder path
 - VMX filename
1. Open an SSH connection to the ESXi host and log in as the root user.
 - a. On the Control Center desktop, double-click the **PuTTY** shortcut.
 - b. In the PuTTY window, double-click the **ESXi Host** session.
 - c. Log in as root with the standard lab password.
 2. Navigate to the Win01 virtual machine folder.

```
cd folder_path
```

Replace *folder_path* with the VMX folder path.
 3. Display the VMX settings related to the virtual network interface.

```
grep ethernet0 filename
```

Replace *filename* with the VMX filename.
 4. Using the command output, verify the configuration values.
 - The generated address begins with 00:50:56 (the default VMware® media access control address prefix).
 - The network interface device is present (TRUE value).
 5. Record the VMX settings.
 - ethernet0.dvs.switchId (first four values) _____
 - ethernet0.dvs.portId _____
 - ethernet0.dvs.portgroupId _____
 - ethernet0.dvs.connectionId _____

The configuration settings that you record are used in the next task.

Task 4: Examine net-dvs Output

The `net-dvs` command provides in-depth reporting of distributed switch configurations.

Student A and student B should do this task independently.

1. Maximize the PuTTY (ESXi session) window.
2. In the PuTTY window, display the `net-dvs` output.

```
net-dvs | less
```

The `net-dvs` output is displayed as a hierarchy that starts with a switch identifier (Id).

3. In the command output, find the switch that the Win01 virtual machine is attached to.
 - a. In the first line of the output, determine if the switch identifier matches the `ethernet0.dvs.switchId` value that you recorded in the previous task.

```
switch 06 6a 3c 50 55 4c 1d 54-71 03 5a a2 3e
    max ports: 1536
    global properties:
```

- b. If the switch identifier in the output matches the value that you recorded earlier, continue to step 4.
- c. Press `Ctrl+F` repeatedly until the start of the next switch section appears and verify that the switch identifier matches the value that you recorded earlier.

Only two distributed switches are defined. If the first switch identifier does not match your recorded value, then the second switch identifier must match the recorded value.

If you accidentally pass the start of the next switch section, press `Ctrl+B` to scroll back through the output.

4. In the switch section that you chose, find the `switch > global properties` section and determine the `switch_name` of the virtual switch.

```
com.vmware.common.alias = switch_name
```

5. Press `Ctrl+F` to find a port section where the port identifier matches the value you recorded in the previous task.

```
port 0:
    com.vmware.common.port.alias = .
    com.vmware.common.port.connectid
    com.vmware.common.port.portgroup:
    com.vmware.common.port.block = fe
    com.vmware.common.port.ptAllowed
```

6. Verify that the connect identifier *Id* matches the value that you recorded in the previous task.

```
com.vmware.common.connectid = Id
```

7. Verify that the port group identifier *Id_value* matches the value that you recorded in the previous task.

```
com.vmware.common.portgroupid = Id_value
```

8. Review the port statistics in the port section that you identified.

```
com.vmware.common.port.statistics
```

NOTE

If you passed this line, press Ctrl+B to display the previous output pages. You can also use the up and down arrows to quickly scroll the information line by line to find the data that you are looking for.

The port statistics can be useful in troubleshooting networking issues. The `pktsInDropped` and `pktsOutDropped` fields can be used to indicate some type of hardware problem or physical network congestion.

This section also reports inbound and outbound traffic. In general, high outbound traffic might indicate that the virtual machines on this port are good candidates for outbound traffic shaping. High inbound traffic levels might reveal a system that needs special treatment to give it high bandwidth or more resources (CPU, RAM, and so on)

9. Press Q to stop the `net-dvs` command.

Task 5: Clean Up for the Next Lab

Perform the following actions to prepare for the next lab.

Student A and student B should do this task independently.

1. To close the PuTTY window (ESXi session), click **OK** to close when prompted.
2. Leave the PuTTY (vSphere Management Assistant session) open and minimized for the next lab.
3. In the Firefox window, leave the **vSphere Web Client** tab open for the next lab.

Lab 7

Policy-Based Storage

Objective: Use policy-based storage to create tiered storage

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Add Datastores for Use by Policy-Based Storage
3. Use vSphere Storage vMotion to Migrate a Virtual Machine to the Gold Datastore
4. Configure Storage Tags
5. Create Virtual Machine Storage Policies
6. Assign Storage Policies to Virtual Machines
7. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client interface if it is not already open.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Select the Firefox window and click the **vSphere Web Client** tab.
 2. Open the vSphere Web Client interface if it is not open.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. Log in as the VMware vSphere® administrator with the standard lab password.
 - d. In the left pane, select **vCenter > Networking**.

Task 2: Add Datastores for Use by Policy-Based Storage

Two small datastores are included in the lab environment for use by your VMware® vCenter Server™ instance as simple tiered storage. Each datastore is approximately 8GB in size.

Student A and student B should do this task independently.

1. In the Firefox window, click the **vSphere Web Client** tab.
2. In the left pane, click the **Storage** icon.



3. Create datastores to be used as simple tiered storage.
 - a. In the Storage inventory tree, select the **Training** data center and select **All vCenter Actions > New Datastore** from the **Actions** drop-down menu.
 - b. In the New Datastore dialog box, click **Next**.
 - c. For type, leave the **VMFS** radio button selected and click **Next**.
 - d. For the datastore name, type **Gold** in the text box.
 - e. Select the VMware® ESXi™ host from the **Select a host** drop-down menu.

- f. In the disk/LUN list, select the first entry that is not a local drive and click **Next**.
Local drives are labeled as VMware Serial Attached. Do not select these drives.

OPNFILER iSCSI Disk (t10.F405E46494C4542537438...
OPNFILER iSCSI Disk (t10.F405E46494C4542596559...
VMware Serial Attached SCSI Disk (mpx.vmhba1:C0:T0:...

- g. For the VMFS version, leave the **VMFS 5** radio button selected and click **Next**.
 - h. Keep the default partition configuration and click **Next**.
 - i. Review the datastore configuration and click **Finish**.
4. Repeat steps 3a through 3i to add the second nonlocal datastore with the datastore name Silver.

Task 3: Use vSphere Storage vMotion to Migrate a Virtual Machine to the Gold Datastore

You manually configure the migration of a virtual machine to one of the new datastores before configuring policy-based storage.

Student A and student B should do this task independently.

1. Migrate the Win01 virtual machine to the Gold datastore, using VMware vSphere® Storage vMotion®.
 - a. In the left pane, click the **Hosts and Clusters** icon.
 - b. In the Hosts and Clusters inventory tree, select the **Win01** virtual machine and select **Migrate** from the **Actions** drop-down menu.
 - c. In the Migrate dialog box, click the **Change datastore** radio button and click **Next**.
 - d. In the datastore list, select the **Gold** datastore, leave all other settings at default values, and click **Next**.
 - e. Review the migration details and click **Finish**.
 - f. In the Recent tasks pane, monitor the migration task to completion.

The migration must complete.
2. In the middle pane, click the **Summary** tab, scroll down to the Related Objects panel, and verify that storage is set to the Gold datastore.

Task 4: Configure Storage Tags

You create the tags necessary to implement simple tiering. The tag category called Storage Tiers contains the Gold and Silver identifier tags to be associated with individual datastores.

Student A and student B should do this task independently.

1. In the left pane, click the **Storage** icon.
2. In the Storage inventory tree, select the **Gold** datastore.
3. In the middle pane, click the **Manage** tab and click the **Tags** button.
4. In the Tags panel, click the **New Tag** icon.



5. Configure a new tag category and the Gold identifier tag.
 - a. For Category, select **New Category** from the drop-down menu.

Selecting New Category expands the dialog box to include both tag and category configuration options. Categories can only be created as part of the identifier tag creation process.
 - b. Type **Gold Tier** in the **Name** text box.
 - c. Type **Storage Tiers** in the **Category Name** text box.
 - d. Click **OK** to accept the default values for the remaining settings.
6. In the Storage inventory tree, select the **Silver** datastore.
7. In the middle pane, click the **New Tag** icon.
8. Configure a new tag for the Silver datastore.
 - a. Type **Silver Tier** in the **Name** text box.
 - b. For Category, select **Storage Tiers** from the drop-down menu.
 - c. Click **OK**.

Task 5: Create Virtual Machine Storage Policies

Storage policies are assigned to virtual machines and specify the configuration settings to be enforced.

Student A and student B should do this task independently.

1. In the vSphere Web Client interface, click the **Home** icon.
2. In the middle pane, under Monitoring, click **VM Storage Policies**.
3. Enable VM Storage Policies.
 - a. In the Objects panel, click the **Enable VM Storage Policies** icon.



- b. In the Enable VM Storage Policies dialog box, select the ESXi host and click the **Enable** button.
 - c. Scroll down to uncover the Close button and click **Close**.
4. Create a gold tier storage policy.
 - a. In the Objects panel, click the **Create a new VM storage policy** icon.



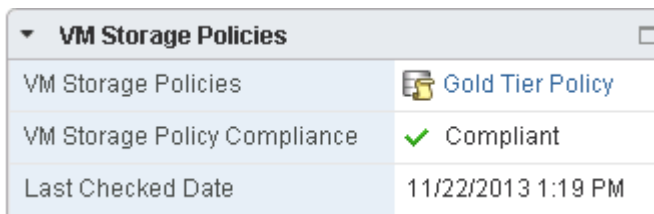
- b. Type **Gold Tier Policy** in the **Name** text box and click **Next**.
 - c. Under Rule Sets, review the information provided and click **Next**.
 - d. For Rule-Set 1, click the **Add tag-based rule** button.
 - e. In the Add Tag-Based Rule dialog box, select **Storage Tiers** from the **Categories** drop-down menu, select the Gold Tier check box, and click **OK**.
 - f. Click **Next**.
 - g. Under Matching resources, verify that the Gold datastore is listed and click **Next**.
 - h. Under Ready to complete, click **Finish**.
5. Repeat steps 4a through 4h to create a Silver Tier Policy, using the Silver Tier tag.



Task 6: Assign Storage Policies to Virtual Machines

Assign the Gold and Silver policies to individual virtual machines and mitigate compliance issues.

Student A and student B should do this task independently.

1. Click the **Home** icon.
2. In the left pane, click **vCenter** and click **Hosts and Clusters**.
3. Apply a VM storage policy to a virtual machine.
 - a. In the Hosts and Clusters inventory tree, select the **Win01** virtual machine and select **All vCenter Actions > VM Storage Policies > Manage VM Storage Policies** from the **Actions** drop-down menu.
 - b. In the Manage VM Storage Policies dialog box, select **Gold Tier Policy** from the drop-down menu and click the **Apply to disks** button.
 - c. In the list, verify that the Gold Storage Policy is assigned to Hard disk 1.
 - d. Click **OK**.
 - e. In the VM Storage Policies panel, verify that the Gold Tier Policy appears and that the policy is compliant.





VM Storage Policies	
VM Storage Policies	 Gold Tier Policy
VM Storage Policy Compliance	 Compliant
Last Checked Date	11/22/2013 1:19 PM

The policy is compliant because the Win01 virtual machine has already been moved to a policy-appropriate datastore.

4. Apply a noncompliant storage policy to a virtual machine.
 - a. In the Hosts and Clusters inventory tree, select the **Win02** virtual machine and select **All vCenter Actions > VM Storage Policies > Manage VM Storage Policies** from the **Actions** drop-down menu.
 - b. In the Manage VM Storage Policies dialog box, select **Silver Tier Policy** from the drop-down menu and click the **Apply to disks** button.
 - c. In the list, verify that the Silver Tier Policy is assigned to Hard Disk 1.
 - d. Click **OK**.

- e. In the VM Storage Policies panel, verify that the Silver Tier Policy appears and that the policy is not compliant.

VM Storage Policies	
VM Storage Policies	 Silver Tier Policy
VM Storage Policy Compliance	 Not Compliant
Last Checked Date	11/22/2013 1:26 PM

The Silver Tier Policy is noncompliant because the Win02 virtual machine disk is stored on a datastore that is not tagged as a part of the assigned policy

5. Remediate the compliance issue.
 - a. Select **Migrate** from the **Actions** drop-down menu.
 - b. In the Migrate dialog box, click the **Change datastore** radio button and click **Next**.
 - c. In the datastore list, select the **Silver** datastore.

With a VM Storage Policy assigned to the Win02 virtual machine, datastores are listed as either Compatible or Incompatible in the migration dialog box.

- d. Click **Next** to leave the default value for all other settings.
- e. Review the migration details and click **Finish**.
- f. In the Recent tasks panel, monitor the migration task to completion.

The migration must complete.

6. In the VM Storage Policies panel, verify that the Silver Tier Policy is reported as compliant.
7. If the Silver Tier Policy is reported as noncompliant, remediate the compliance issue.
 - a. Select **All vCenter Actions > VM Storage Policies > Check VM Storage Policy Compliance** from the **Actions** drop-down menu.
 - b. In the Recent Tasks panel, monitor the compliance check to completion,.
 - c. In the VM Storage Policies panel, verify that the Silver Tier Policy is reported as being compliant.

Task 7: Clean Up for the Next Lab

Perform these steps to prepare for the next lab.

Student A and student B should do this task independently.

1. In the Firefox window, leave the **vSphere Web Client** tab open for the next lab.

Lab 8

Managing Datastore Clusters

Objective: Create a datastore cluster and work with vSphere Storage DRS

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Create a Datastore Cluster That Is Enabled by vSphere Storage DRS
3. Evacuate a Datastore Using Datastore Maintenance Mode
4. Run vSphere Storage DRS and Apply Migration Recommendations
5. Clean Up for the Next Lab



Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client if it is not already open and add the Gold and Silver datastores if they are not present.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Open the vSphere Web Client if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. Log in as the VMware vSphere® administrator with the standard lab password.
 - d. In the left pane, select **vCenter > Hosts and Clusters**.
 2. Add the Gold and Silver datastores if they are not present.
 - a. In the left pane, click the **Storage** icon and expand the Storage inventory tree.
 - b. In the Storage inventory tree, select the **Training** data center and select **All vCenter Actions > New Datastore** from the **Actions** drop-down menu.
 - c. In the New Datastore dialog box, click **Next**.
 - d. For type, leave the **VMFS** radio button selected and click **Next**.
 - e. For the datastore name, type **Gold** in the text box.
 - f. Select the VMware® ESXi™ host from the **Select a host** drop-down menu.
 - g. In the datastore list, select the first datastore that is not a local drive and click **Next**.
Local drives are labeled as VMware Serial Attached. Do not select these drives.
 - h. For the VMFS version, leave the **VMFS 5** radio button selected and click **Next**.
 - i. Keep the default partition configuration and click **Next**.
 - j. Review the datastore configuration and click **Finish**.
 3. Repeat steps 2b through 2j to add the second nonlocal datastore with the datastore name Silver.

Task 2: Create a Datastore Cluster That Is Enabled by vSphere Storage DRS

You create a datastore cluster that is enabled by VMware vSphere® Storage DRS™. The Gold and Silver datastores are reused as members of the cluster.

Student A and student B should do this task independently.

1. In the left pane, click the **Storage** icon.
2. In the Storage inventory tree, select the **Training** data center and select **New Datastore Cluster** from the **Actions** drop-down menu.
3. In the New Datastore Cluster dialog box, create a cluster that is enabled by vSphere Storage DRS.
 - a. Type **Cluster-DRS** in the **Datastore Cluster Name** text box.
 - b. Leave the **Turn ON Storage DRS** check box selected and click **Next**.
 - c. Leave the **No Automation (Manual Mode)** radio button selected and click **Next**.
 - d. Leave all Storage DRS Runtime Settings at default values and click **Next**.
 - e. In the Filter panel, click the **Standalone Hosts** button, select the ESXi host check box, and click **Next**.
 - f. In the datastore list, select the **Gold** and **Silver** check boxes and click **Next**.
 - g. Review the configuration summary and click **Finish**.

In a production environment, the best practice is to select datastores that are connected to all hosts in the cluster, and group them by storage capabilities.

4. In the Storage inventory tree, expand **Cluster-DRS** and verify that both the Gold and Silver datastores appear.



5. Select the **Gold** datastore.
6. In the middle pane, click the **Summary** tab.
7. In the Details panel, verify that only one virtual machine is using the datastore.
8. Select the **Silver** datastore.
9. In the Details panel, verify that only one virtual machine is using the datastore.

10. In the Storage inventory tree, select **Cluster-DRS**.
11. In the middle pane, click the **Manage** tab and click the **Settings** button.
12. Under Services, select the **Storage DRS** link.
13. In the vSphere Storage DRS panel, expand each item and verify the settings.
 - Automation Level is set to No Automation (Manual Mode).
 - Utilized Space Threshold is 80 percent.
 - I/O metrics for Storage DRS recommendations are enabled.
 - Imbalances are checked every 8 hours.
 - Minimum Space Utilization Difference is 5 percent.

Task 3: Evacuate a Datastore Using Datastore Maintenance Mode

To demonstrate capabilities of vSphere Storage DRS, the virtual machine stored on the Silver datastore is migrated to the Gold datastore. This migration creates a cluster imbalance.

1. In the Storage inventory tree, select the **Silver** datastore and select **All vCenter Actions > Enter Maintenance Mode** from the **Actions** drop-down menu.
2. In the SDRS Maintenance Mode Migration Recommendations dialog box, read the provided recommendation description.
3. Leave the **Apply** check box selected and click **Apply Recommendations**.
The Win02 virtual machine is migrated to the Gold datastore.
4. In the Recent Tasks pane, monitor the migration task to completion.
5. In the Storage inventory tree, verify that the Silver Tier datastore is in maintenance mode.



6. Click the **Refresh** icon, located on the left of the logged in user name, at the top of the vSphere Web Client interface.
7. In the Details panel, verify that zero virtual machines are stored on the Silver datastore.
8. Select **All vCenter Actions > Exit Maintenance Mode** from the **Actions** drop-down menu.
9. In the Storage inventory tree, verify that the Silver datastore icon no longer indicates maintenance mode.

Task 4: Run vSphere Storage DRS and Apply Migration Recommendations

vSphere Storage DRS can be configured to maintain a balance in usage across all datastores in a cluster. The cluster imbalance is mitigated using vSphere Storage DRS recommendations.

Student A and student B should do this task independently.

1. In the Storage inventory tree, select **Cluster-DRS**.
2. In the middle pane, click the **Manage** tab and click the **Settings** button.
3. Under Services, select the **Storage DRS** link.
4. Configure vSphere Storage DRS so that recommendations are reported.
 - a. In the vSphere Storage DRS panel, click the **Edit** button.
 - b. In the Edit Storage DRS Settings dialog box, expand the **Storage DRS Automation** section.
 - c. Move the **Utilized Space Threshold** slider to the far left to set the threshold to 50 percent.
The imbalance between the Gold and Silver datastore utilization is detected at a 50 percent space threshold trigger.
 - d. Click **OK**.
5. Run vSphere Storage DRS and review recommendations.
 - a. In the middle pane, click the **Monitor** tab and click the **Storage DRS** button.
 - b. Click the **Recommendations** link and click the **Run Storage DRS Now** button.
When the task completes, a vSphere Storage DRS recommendation appears in the recommendation list.
 - c. Review the recommendation and reason.
vSphere Storage DRS recommends that the Win02 Hard disk 1 be moved from the Gold datastore to the Silver datastore to balance datastore usage in the cluster.
6. Examine the vSphere Storage DRS recommendation alarm.
 - a. In the middle panel, click the **Summary** tab and find the yellow vSphere Storage DRS recommendation alarm.
The administrator can reset the recommendation alarm manually. Additionally, the vSphere Storage DRS recommendation alarm is reset when the recommendation is applied.

7. Apply the vSphere Storage DRS recommendation.
 - a. In the middle pane, click the **Monitor** tab.
 - b. At the bottom-right corner of the Storage DRS Recommendations panel, click the **Apply Recommendations** button.
 - c. In the Recent Tasks pane, monitor the migration task to completion.
8. In the middle panel, click the **Summary** tab and verify that the yellow vSphere Storage DRS recommendation alarm no longer appears.
9. Review vSphere Storage DRS history.
 - a. In the middle pane, click the **Monitor** tab.
 - b. Below the Recommendations link, click the **History** link.
 - c. Verify that the vSphere Storage DRS history reports the actions.
 - Migrate hard disk Hard disk 1 for Win02 from Gold to Silver
 - Migrate hard disk Hard disk 1 for Win02 from Silver to Gold

The second event occurs when the Silver datastore is originally evacuated.

Task 5: Clean Up for the Next Lab

Perform the following actions to prepare for the next lab.

Student A and student B should do this task independently.

1. In the Storage inventory tree, select **Cluster-DRS** and select **All vCenter Actions > Remove From Inventory** from the **Actions** drop-down menu.
2. When prompted, click **Yes** to remove the datastore cluster.
3. After the cluster is removed, verify that the Gold and Silver datastores appear in the Storage inventory tree, under the Training data center.
4. In the Firefox window, leave the **vSphere Web Client** tab open for the next lab.

Lab 9

Monitoring Storage Performance

Objective: Use a vSphere advanced chart to monitor disk performance across a series of tests

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Prepare the Test Virtual Machine
3. Prepare the IP Storage Network for Testing
4. Create a Real-Time Disk I/O Performance Chart
5. Prepare to Run Tests
6. Measure Continuous Sequential Write Activity to a Virtual Disk on a Remote Datastore
7. Measure Continuous Random Write Activity to a Virtual Disk on a Remote Datastore
8. Measure Continuous Random Read Activity to a Virtual Disk on a Remote Datastore
9. Measure Continuous Random Read Activity to a Virtual Disk on a Local Datastore
10. Analyze the Test Results
11. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client interface if it is not already open.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Open the vSphere Web Client if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. Log in as the VMware vSphere® administrator with the standard lab password.
 - d. In the left pane, click **vCenter** and click **Storage**.

Task 2: Prepare the Test Virtual Machine

On the test virtual machine, several test scripts are used to generate continuous random and sequential I/O operations against both local and remote (network) datastores. The Linux01 virtual machine is used as the test controller. Two new hard drives are added to the virtual machine to serve as local and remote I/O targets.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
 - ESXi local datastore name
1. In the inventory tree, click the **Hosts and Clusters** icon.
 2. Power off the test virtual machine.
 - a. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Shut Down Guest OS** from the **Actions** drop-down menu.
 - b. When prompted, click **Yes** to confirm guest shutdown.
 - c. In the inventory tree, monitor the shutdown until the running indicator stops appearing on Linux01.
 - d. In the Firefox window, close the **Linux01** console tab.
 3. Add two new SCSI hard drives to the Linux01 virtual machine.
 - a. In the middle pane, click the **Manage** tab and click the **Settings** button.

- b. Click the **VM Hardware** link and click the **Edit** button.
- c. Select **New Hard Disk** from the **New Device** drop-down menu, located near the bottom of the Edit Settings dialog box.
- d. Click the **Add** button twice to create two new hard disk items.



4. Configure each new hard disk, starting with the topmost drive that has been added to the hardware list.

The new drives must be configured in a specific sequence. The SCSI (0:1) drive must be stored locally to the VMware® ESXi™ host and the SCSI (0:2) drive must be stored on a remote datastore. Ensure that you configure the drives properly. If the drives are not configured exactly as directed, tests do not produce significant statistics.

- a. To expand the device properties panel, click the > icon.
- b. In the device properties, find the Virtual Device Node drop-down menu, located about halfway down the panel.



- c. Record the virtual device node to be assigned to the current drive being configured.
 - Virtual device node for the first disk configured _____
 - Virtual device node for the second disk configured _____

The virtual device node is either SCSI (0:1) or SCSI (0:2).

- d. For the hard disk size, type **8** in the text box and leave the unit as **GB**.
- e. Click the **Location** drop-down menu, select **Browse**, and select a datastore.
 - For the SCSI (0:1) New Hard Disk virtual device node, select your ESXi host local datastore.
 - For the SCSI (0:2) New Hard Disk virtual device node, select the **Shared** datastore.
- f. Click **OK**.
- g. For Disk Provisioning, select the **Thin Provision** radio button.
- h. To leave all other settings at default value, collapse the device properties panel.

5. Repeat step 4 to configure the second new hard disk.
6. When both the hard disks are configured, click **OK** to commit the changes.
7. In the Recent Tasks pane, monitor the reconfiguration task to completion.
8. Power on the Linux01 virtual machine and prepare the new hard drives for use.
 - a. Select **Power On** from the **Actions** drop-down menu.
 - b. After the virtual machine powers on, select **Open Console** from the **Actions** drop-down menu.
 - c. Log in as root with the standard lab password.
 - d. In the Linux01 console, right-click the desktop and select **Open Terminal**.
 - e. In the Terminal window, configure storage.

```
./storageconfig.sh
```

It might take a few minutes for the storage preparation to complete. The script must run uninterrupted to complete. You can continue while the new disks are being prepared.

Task 3: Prepare the IP Storage Network for Testing

The IP storage-related port group is throttled, using traffic shaping, so that the attached nodes are effectively constrained to a more easily measured condition. Traffic shaping is used to constrain the network to a 100Mb/s throughput. The ESXi host ability to access shared storage across the network can be controlled by throttling the port group to which the VMkernel is connected for IP storage operations.

Student A and student B should do this task independently.

1. In the Firefox window, click the **vSphere Web Client** tab.
2. In the left pane, click the **Networking** icon.
3. In the Networking inventory tree, expand the **dvs-Infrastructure** distributed switch item and select the **pg-IPStorage** port group.
4. Configure traffic shaping to constrain the **pg-IPStorage** port group to 100Mbits/s.
 - a. In the middle pane, click the **Manage** tab and click the **Settings** button.
 - b. Select the **Properties** link and click the **Edit** button.
 - c. In the Edit Settings dialog box, select the **Traffic Shaping** link in the left pane.

- d. Configure both Ingress and Egress traffic shaping.

Option	Action
Status	Select Enabled from the drop-down menu.
Average bandwidth (kbit/s)	Keep the default of 100000.
Peak bandwidth (kbits/s)	Keep the default of 100000.
Burst size (KB)	Type 100000 in the text box.

- e. After configuring both Ingress and Egress, click **OK** to commit the traffic shaping changes.

Task 4: Create a Real-Time Disk I/O Performance Chart

You define and save the advanced chart criteria for monitoring disk I/O performance across the four tests to be performed.

Student A and student B should do this task independently.

1. In the inventory tree, click the **Hosts and Clusters** icon.
2. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine.
3. In the middle pane, click the **Monitor** tab and click the **Performance** button.
4. Select the **Advanced** link to display the advanced charts.
5. In the Advanced chart view, select **Disk** from the **View** drop-down menu.
6. After the Disk chart appears, verify that the View selection is **Disk** and click the **Chart Options** link.
7. Configure and save a customized performance chart.
 - a. For Timespan, leave **Real-time** selected.
 - b. In the Select objects for this chart panel, click the **None** button and select the **Linux01** check box.
 - c. For Chart Type, leave **Line Graph** selected.
 - d. In the Select counters for this chart panel, click the **None** button and select the **Read rate** and **Write rate** check boxes.
 - e. At the top of the dialog box, click the **Save Options as** button, type **Lab09** in the **Chart options name** text box, and click **OK**.
 - f. Click **OK** to close the Chart Options dialog box.

- g. In the Advanced chart panel, verify that the **View** selection is set to **Lab09**.
You refer to this chart till the completion of this lab.
- h. To increase the performance chart view area and collapse the links panel, click the << icon.

Task 5: Prepare to Run Tests

You wait for storage preparation to complete and continue to the next test.

Student A and student B should do this task independently.

1. In the Firefox window, click the **Linux01** console tab.
2. In the Linux01 console, verify that the storage preparation script has completed in the terminal window.

If the script has not completed, wait until the script is complete.

3. In the terminal window, navigate to the test scripts folder.

```
cd aio-stress
```

Task 6: Measure Continuous Sequential Write Activity to a Virtual Disk on a Remote Datastore

The second drive added to the Linux01 virtual machine, with a virtual device node of SCSI (0:2), is stored on the shared datastore. The first test script generates continuous sequential write activity to that hard disk located on the remote datastore.

Student A and student B should do this task independently.

1. In the terminal window, start the first test script.

```
./logwrite.sh
```
2. Continue while the script runs uninterrupted.
3. In the Firefox window, click the **vSphere Web Client** tab.
4. Click the chart **Refresh** icon that appears to the right of the **View** button, above the chart.

If necessary, scroll to the right on the chart pane to uncover the chart refresh icon.

5. After statistics are collected for 30 seconds, scroll down to uncover the Performance Chart Legend.
6. If your display does not show the entire Performance Chart Legend, note the order in which the Read rate and Write rate counters appear in the table.

When measuring all four tests, the counters remain in the same order.

7. If necessary, scroll right to uncover the counter value columns.

Resizing the Rollup and Units columns to a smaller width frees up additional horizontal space for the other columns to the right.

8. Record the **Latest** column values.

- **Read rate** _____
- **Write rate** _____

You might want to observe the Latest column value for a few moments to determine an approximate average value. The value can fluctuate occasionally with significant deviation.

9. In the Firefox menu, click the **Linux01** console tab.
10. In the Linux01 console, select the terminal window and press Ctrl+C to stop the test script.

Task 7: Measure Continuous Random Write Activity to a Virtual Disk on a Remote Datastore

The second test script generates continuous sequential write activity to the virtual machine hard disk located on the remote datastore.

Student A and student B should do this task independently.

1. In the terminal window, start the second test script.

```
./datawrite.sh
```

2. Continue while the script runs uninterrupted.
3. In the Firefox window, click the **vSphere Web Client** tab.
4. Click the chart **Refresh** icon.
5. After statistics are collected for 30 seconds, scroll down to uncover the Performance Chart Legend counter value columns.
6. Record the **Latest** column values.
 - **Read rate** _____
 - **Write rate** _____
7. In the Firefox window, click the **Linux01** console tab.
8. In the Linux01 console, select the terminal window and press Ctrl+C to stop the test script.

Task 8: Measure Continuous Random Read Activity to a Virtual Disk on a Remote Datastore

The third test script generates continuous random read activity from the hard disk located on the remote datastore.

Student A and student B should do this task independently.

1. In the terminal window, start the third test script.

```
./fileserv2.sh
```

2. Continue while the script runs uninterrupted.
3. In the Firefox window, click the **vSphere Web Client** tab.
4. Click the chart **Refresh** icon.
5. After statistics are collected for 30 seconds, scroll down to uncover the Performance Chart Legend counter value columns.
6. Record the **Latest** column values.
 - **Read rate** _____
 - **Write rate** _____
7. In the Firefox window, click the **Linux01** console tab.
8. In the Linux01 console, select the terminal window and press Ctrl+C to stop the test script.

Task 9: Measure Continuous Random Read Activity to a Virtual Disk on a Local Datastore

The final test script generates continuous random read activity from the virtual machine hard disk located on the local datastore attached to the ESXi host.

Student A and student B should do this task independently.

1. In the Linux01 terminal window, start the fourth test script.

```
./fileserv1.sh
```

This test script first creates the file to be read, which can take up to 5 minutes or more.

The test script must run uninterrupted.

2. Monitor the script output
The output remains silent during file creation.
3. After the *Starting with random read* message appears, in the Firefox window, click the **vSphere Web Client** tab.

4. Click the chart **Refresh** icon.
5. After statistics are collected for 30 seconds, scroll down to uncover the Performance Chart Legend counter value columns.
6. Record the **Latest** column values.
 - **Read rate** _____
 - **Write rate** _____
7. In the Firefox window, click the **Linux01** console tab.
8. In the Linux01 console, select the terminal window and press Ctrl+C to stop the test script.
9. Close the terminal window.
10. In the Firefox window, click the **vSphere Web Client** tab.

Task 10: Analyze the Test Results

Your instructor conducts an in-class review of the test results.

Student A and student B should do this task independently.

1. Record the conclusions that you can draw from the test data collected in tasks 6 to 9.

Task 11: Clean Up for the Next Lab

Perform these steps to prepare for the next lab.

Student A and student B should do this task independently.

1. Disable traffic shaping on the **dvs-Infrastructure > pg-IPStorage** port group.
 - a. In the left pane, click the **Networking** icon.
 - b. In the Networking inventory tree, under the **dvs-Infrastructure** distributed switch item, select the **pg-IPStorage** port group.
 - c. In the middle pane, click the **Manage** tab and click the **Settings** button.
 - d. Select the **Properties** link and click the **Edit** button.
 - e. In the Edit Settings dialog box, select the **Traffic Shaping** link in the left pane.
 - f. For both the Ingress and Egress options, select **Disabled** from the drop-down menu.
 - g. Click **OK** to commit the traffic shaping changes.
2. In the Firefox window, leave the **vSphere Web Client** and the **Linux01** tabs open for the next lab.

Lab 10

Command-Line Storage Management

Objective: Use various command-line tools to manage and monitor storage

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Use the ESXCLI Commands to View Storage Configuration Settings
3. Use the vmkfstools Commands to Manage Volumes and Virtual Disks
4. Generate Disk Activity in a Test Virtual Machine
5. Start the vscsiStats Commands to Collect Virtual Machine Statistics
6. Generate a Disk Latency Histogram
7. Generate the First Seek Distance Histogram
8. Start the Next Test Script and Collect Statistics
9. Generate the Second Seek Distance Histogram and Compare the Data
10. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You restore the VMware vSphere® Management Assistant session, open the VMware vSphere® Web Client interface, and power on the virtual machine.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - vSphere Management Assistant administrator user name
 - Standard lab password
 - ESXi FQDN
1. Restore the minimized PuTTY (vSphere Management Assistant session) window.
 2. Open the PuTTY window if it is closed.
 - a. On the Control Center desktop, double-click the **PuTTY** shortcut.
 - b. In the PuTTY window, double-click the **vSphere Management Assistant** session.
 - c. Log in as the vSphere Management Assistant administrator with the standard lab password.
 - d. Maximize the PuTTY window.
 - e. Set the VMware® ESXi™ host as the target server.

```
vifptarget -s server
```

Replace *server* with the ESXi FQDN.
 3. Open the vSphere Web Client interface if it is not open.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.
 - d. In the left pane, click **vCenter** and click **Hosts and Clusters**.
 4. Power on the Linux01 virtual machine if it is not powered on.
 - a. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine.
 - b. Select **Power On** from the **Actions** drop-down menu.

5. In the Firefox window, open the **Linux01** console tab if it is closed.
 - a. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Open Console** from the **Actions** drop-down menu.
 - b. If prompted to log in, log in as root with the standard lab password.
 - c. In the vSphere Web Client, click the **Home** icon.
 - d. In the left pane, click **vCenter** and click **Networking**.
 - e. Expand the **dvs-Infrastructure** distributed switch item and select the **pg-IPStorage** port group.

Task 2: Use the ESXCLI Commands to View Storage Configuration Settings

Use ESXCLI commands to review storage-related configuration settings for a host.

Student A and student B should do this task independently.

1. Restore the PuTTY window.
2. List all storage adapters on the ESXi host.
`esxcli storage core adapter list`

3. Retrieve statistics for all storage adapters.
`esxcli storage core adapter stats get`

Scroll through the list of adapters to find evidence that any operations have failed.

4. List all available storage partitions.
`esxcli storage core device partition list`
5. List all paths to storage devices.
`esxcli storage core path list`

Task 3: Use the `vmkfstools` Commands to Manage Volumes and Virtual Disks

Use the `vmkfstools` commands to manage virtual machine disk files.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- ESXi local datastore name

1. View the `vmkfstools` help.

```
vmkfstools -help
```

2. View the local datastore attributes.

```
vmkfstools -P [datastore_name]
```

Replace `datastore_name` with the name of the ESXi host local datastore, keeping the [] brackets.

Example: If the local datastore name is `Local01`, you run the following command:

```
vmkfstools -P [Local01]
```

3. Create a 10MB thin-provisioned virtual disk on the ESXi local datastore.

```
vmkfstools -c 10m -d thin '[datastore_name] test.vmdk'
```

Replace `datastore_name` with the name of the ESXi host local datastore, keeping the [] brackets and single quotation marks. The datastore name is case-sensitive.

A 10MB virtual disk file named `test.vmdk` is created.

4. Rename the virtual disk.

```
vmkfstools -E '[datastore_name] test.vmdk' '[datastore_name]
renamed.vmdk'
```

5. Convert the virtual disk provisioning to eagerzeroedthick.

```
vmkfstools -j '[datastore_name] renamed.vmdk'
```

6. Display the virtual disk geometry.

```
vmkfstools -g '[datastore_name] renamed.vmdk'
```

The geometry option reports the number of cylinders, heads, and sectors of the disk.

7. Extend the size of the virtual disk by 10MB in eagerzeroedthick format.

```
vmkfstools -X 20m -d eagerzeroedthick '[datastore_name]
renamed.vmdk'
```


8. Display the updated virtual disk geometry and review the geometry changes to determine how the geometry changed in response to increasing the disk size by 20MB.

```
vmkfstools -g '[datastore_name] renamed.vmdk'
```

9. Remove the virtual disk.

```
vmkfstools -U '[datastore_name] renamed.vmdk'
```

10. Minimize the PuTTY (vSphere Management Assistant session) window.

Task 4: Generate Disk Activity in a Test Virtual Machine

A test virtual machine runs two different scripts that generate disk activity. One script generates continuous sequential write operations to the local datastore, and the other script generates continuous random write operations to the local datastore. Using histograms, you can determine which script generates the sequential I/O and which script performs the random I/O. You generate disk activity using the first test script.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Restore the Firefox window and click the **Linux01** console tab.
 2. Start the first test script.
 - a. If a terminal window is not open on the Linux01 desktop, right-click the desktop and select **Open Terminal**.
 - b. In the terminal window, navigate to the test scripts folder.

```
cd aio-stress
```
 - c. Start the first test script.

```
./datawrite.sh
```
 3. Continue to the next task while the script runs uninterrupted.

Task 5: Start the `vscsiStats` Commands to Collect Virtual Machine Statistics

You use the `vscsiStats` command to obtain information that uniquely identifies virtual machines and hard disks.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
1. Minimize the Firefox window.
 2. Use PuTTY to open an SSH session to the ESXi host.
 - a. On the Control Center desktop, double-click the **PuTTY** shortcut icon.
 - b. In the PuTTY window, double-click the **ESXi Host** session.
 - c. Log in as root with the standard lab password.
 3. Maximize the PuTTY (ESXi session) window.
 4. List available virtual machines.

```
vscsiStats -l
```

The command is case-sensitive. Type the command exactly as shown, using the same uppercase and lowercase pattern.

5. In the command output, find the section for the Linux01 virtual machine.

Each section begins with a *worldGroupID*, which follows the virtual machine display name.

```
Virtual Machine worldGroupID: 392022, Virtual Machine Display Name: Linux01
Virtual Machine Config File: /vmfs/volumes/529165ad-5560da18-47da-0050560149
Linux01/Linux01.vmx, {
  Virtual SCSI Disk handleID: 8209 (scsi0:0)
  Virtual SCSI Disk handleID: 8210 (scsi0:1)
  Virtual SCSI Disk handleID: 8211 (scsi0:2)
```

6. In the Linux01 section, find the *worldGroupID* and find the *handleID* for the scsi0:2 disk. You are asked to type both values as part of the next command.

```
Virtual Machine worldGroupID: 392022, Virtual Machine Display Name: Linux01
Virtual Machine Config File: /vmfs/volumes/529165ad-5560da18-47da-0050560149
Linux01/Linux01.vmx, {
  Virtual SCSI Disk handleID: 8209 (scsi0:0)
  Virtual SCSI Disk handleID: 8210 (scsi0:1)
  Virtual SCSI Disk handleID: 8211 (scsi0:2)
```

7. Begin capturing virtual machine statistics.

```
vscsiStats -s -w worldGroupID -i handleID
```

Replace *worldGroupID* and *handleID* with values that you discovered in the previous step.

By default, only the *worldGroupID* is required. When only a *worldGroupID* is specified, the collection is started for each disk attached to the specified virtual machine. This approach can make reading histogram reports more difficult.

Including both a *worldGroupID* and a *handleID* constrains data collection and histogram reporting to a specific disk attached to a specific virtual machine. This approach reduces the amount of ESXi resources needed for collecting data. The histogram reports become more readable. Additionally, certain options, such as *-t* (trace), consume significant system resources and VMware® recommends constraining a collection when using such options.

Task 6: Generate a Disk Latency Histogram

You use *vscsiStats* to display the histogram data set for disk latency.

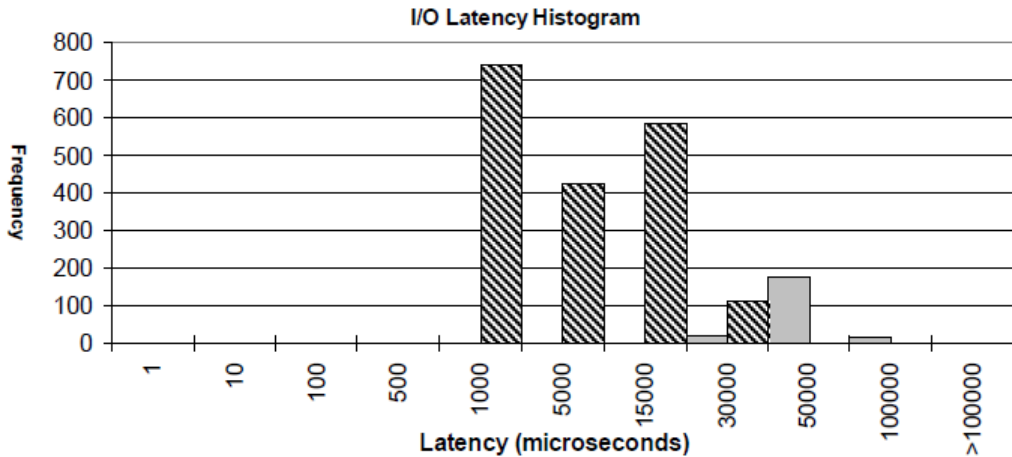
Student A and student B should do this task independently.

1. Generate a disk latency histogram.

```
vscsiStats -p latency
```

The command output is many pages in length. The write I/O latency data set appears last. If necessary, use the PuTTY window scroll bar to review the information.

- (Optional) Using the histogram output, sketch a write I/O latency graph for the scsi0:2 device. The illustration shows an example of such a graph.



- Generate a comma-delimited version of the histogram.

```
vscsiStats -p latency -c
```

Use the `-p` option with the `-c` switch, to generate a comma-delimited output appropriate for import into other tools for analysis.

Task 7: Generate the First Seek Distance Histogram

Generate the first of two seek distance histograms.

Student A and student B should do this task independently.

- Generate a seek distance histogram for the current test.

```
vscsiStats -p seekDistance
```

The command output is many pages in length. Use the PuTTY vertical scroll bar to find the data set labeled as Histogram: distance (in LBNs) between successive Write commands.

2. Review the data set and determine if the reported seek distances are scattered across the range.

The diagram shows an example output.

299	(<=	-500000)
815	(<=	-100000)
552	(<=	-50000)
1014	(<=	-10000)
238	(<=	-5000)
226	(<=	-1000)
78	(<=	-500)
255	(<=	-128)
63	(<=	-64)
16	(<=	-32)
5	(<=	-16)
9	(<=	-8)
1	(<=	-6)
0	(<=	-4)
0	(<=	-2)
0	(<=	-1)
0	(<=	0)
16396	(<=	1)
0	(<=	2)
0	(<=	4)
0	(<=	6)
0	(<=	8)
3408	(<=	16)
188	(<=	32)
4491	(<=	64)
122	(<=	128)
290	(<=	500)
330	(<=	1000)
1385	(<=	5000)
1250	(<=	10000)
4656	(<=	50000)
1526	(<=	100000)
732	(<=	500000)
5	(>	500000)

Task 8: Start the Next Test Script and Collect Statistics

You start the second script and instruct `vscsiStats` to begin collecting fresh data.

Student A and student B should do this task independently.

1. Restore the minimized Firefox window.
2. In the Linux01 console, select the terminal window and press Ctrl+C to stop the test script.
3. Start the second test script.

```
./logwrite.sh
```

4. Minimize the Firefox window.
5. Reset the `vscsiStats` collection.

```
vscsiStats -r
```

6. After 30 seconds of statistics collection, continue to the next task.

Task 9: Generate the Second Seek Distance Histogram and Compare the Data

Generate the second seek distance histogram.

Student A and student B should do this task independently.

1. Generate a seek distance histogram for the current test.

```
vscsiStats -p seekDistance
```

2. Use the PuTTY vertical scroll bar to find the data set labeled as Histogram: distance (in LBNs) between successive Write commands.

This data set is the next to last in the command output.

3. Review the data set and determine if the reported seek distances are scattered across the range.

The diagram shows an example output.

23	(<=	-500000)
0	(<=	-100000)
0	(<=	-50000)
0	(<=	-10000)
0	(<=	-5000)
0	(<=	-1000)
0	(<=	-500)
0	(<=	-128)
0	(<=	-64)
0	(<=	-32)
0	(<=	-16)
0	(<=	-8)
0	(<=	-6)
0	(<=	-4)
0	(<=	-2)
0	(<=	-1)
0	(<=	0)
76880	(<=	1)
0	(<=	2)
0	(<=	4)
0	(<=	6)
0	(<=	8)
1916	(<=	16)
4	(<=	32)
0	(<=	64)
0	(<=	128)
0	(<=	500)
0	(<=	1000)
51	(<=	5000)
0	(<=	10000)
6	(<=	50000)
0	(<=	100000)
0	(<=	500000)
27	(>	500000)

4. Based on your observations, answer questions.

Q1. Which test script generates sequential write operations?

Q2. How did you come to the conclusion?

Task 10: Clean Up for the Next Lab

Perform these actions to prepare for the next lab.

Student A and student B should do this task independently.

1. Stop `vscsiStats` collection.

```
vscsiStats -x
```

2. Click **OK** to close the PuTTY (ESXi session) window.
3. Restore the minimized Firefox window.
4. In the Linux01 console, select the terminal window and press Ctrl+C to stop the test script.
5. In the Linux01 console, close the terminal window.
6. In the Firefox window, leave the **vSphere Web Client** and the **Linux01** tabs open for the next lab.
7. Leave the minimized PuTTY (vSphere Management Assistant session) window open and minimized for the next lab.

Lab 11

Monitoring CPU Performance

Objective: Use advanced performance charts and the `resxtop` command to monitor CPU performance

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Run a Single-Threaded Program in a Single-vCPU Virtual Machine
3. Start `resxtop` and Record Baseline Statistics
4. Configure an Advanced Performance Chart and Record Baseline Statistics
5. Import the CPU-HOG vApp
6. Generate CPU Contention
7. Record Statistics for Case 1: Single Thread and Single vCPU
8. Run a Single-Threaded Program on a Virtual Machine with Two vCPUs
9. Record Statistics for Case 2: One Thread and Two vCPUs
10. Run a Dual-Threaded Program in a Dual-vCPU Virtual Machine
11. Record Statistics for Case 3: Two Threads and Two vCPUs
12. Analyze the Test Results
13. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client, power on the virtual machine, and open the PuTTY (VMware vSphere® Management Assistant) window.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - vSphere Management Assistant administrator user name
 - Standard lab password
 - ESXi FQDN
1. Open the vSphere Web Client if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.
 - d. In the left pane, click **vCenter** and click **Networking**.
 2. If the Linux01 virtual machine is not powered on, in the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Power On** from the **Actions** drop-down menu.
 3. In the Firefox window, open the **Linux01** console tab if it is closed.
 - a. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Open Console** from the **Actions** drop-down menu.
 - b. If prompted to log in, log in as root with the standard lab password.
 4. Restore the PuTTY (vSphere Management Assistant session) window that was minimized at the end of an earlier lab.
 5. If the PuTTY window is closed, log in to the vSphere Management Assistant and set the ESXi host as the target server.
 - a. On the Control Center desktop, double-click the **PuTTY** shortcut.
 - b. In the PuTTY window, double-click the **vSphere Management Assistant** session.
 - c. Log in as the vSphere Management Assistant administrator with the standard lab password.
 - d. Maximize the PuTTY window.

- e. Set the VMware® ESXi™ host as the target server.

```
vifptarget -s server
```

Replace *server* with the ESXi FQDN.

6. Switch to the Firefox window.

Task 2: Run a Single-Threaded Program in a Single-vCPU Virtual Machine

A test program generates continuous database activity on the test virtual machine for statistical analysis.

Student A and student B should do this task independently.

1. In the Firefox window, click the **vSphere Web Client** tab.
2. Shut down all running virtual machines except the Linux01 test machine.
 - a. In the inventory tree, click the **Hosts and Clusters** icon.
 - b. In the Hosts and Clusters inventory tree, under the ESXi host, select a running virtual machine and select **Shut Down Guest OS** from the **Actions** drop-down menu.
 - c. Repeat step 2b for each running virtual machine that is not Linux01.
3. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine.
4. In the middle pane, click the **Summary** tab.
5. In the VM Hardware panel, verify that the virtual machines have a single virtual CPU (vCPU).
6. In the Firefox window, click the **Linux01** console tab.
7. On the Linux01 desktop, right-click the desktop and select **Open Terminal**.
8. Start the test program.

```
./startttest1
```

The test program generates database operations to a medium-size database and writes output to the screen. The program must run uninterrupted.

Task 3: Start `resxtop` and Record Baseline Statistics

The `resxtop` and `esxtop` commands can be used to observe and record baseline performance statistics for supported objects, before starting prescribed tests.

Student A and student B should do this task independently.

1. Switch to the PuTTY (vSphere Management Assistant session) window.

2. Start `resxtop`.

```
resxtop
```

By default, `resxtop` starts with the CPU screen.

3. Change the update delay from the default (5 seconds) to 10 seconds.

a. Type `s`.

b. Type `10`.

c. Press Enter.

4. To filter the CPU screen output to the virtual machines only, type uppercase `v`.

By default, the CPU screen shows statistics for virtual machine processes and active ESXi host processes.

5. In the output table, find the Linux01 virtual machine statistics.

The Linux01 statistics should be the only row that is displayed.

6. Record the following counter values in the Baseline Data column of table 1.

- %USED
- %SYS
- %RDY

Task 4: Configure an Advanced Performance Chart and Record Baseline Statistics

The baseline statistics are recorded with the single-thread, single-vCPU test running, before the introduction of CPU contention.

Student A and student B should do this task independently.

1. Switch to the Firefox window and click the **vSphere Web Client** tab.

2. In the inventory pane, verify that Linux01 is selected.

3. In the middle pane, click the **Monitor** tab.

If the CPU performance chart is already displayed in the center pane, continue to step 5.

4. Display the CPU performance chart if it is not displayed.

a. In the middle pane, click the **Performance** button.

- b. Select the **Advanced** link.
 - c. In the Advanced chart view, click the **View** button and select **CPU**.
5. Click the **Chart Options** link.
6. Configure and save your test chart.
 - a. For Timespan, leave **Real-time** selected.
 - b. In the Select object for this chart panel, click **None** and select the **Linux01** check box.
 - c. For Chart Type, leave **Line Graph** selected
 - d. In the Select counters for this chart panel, click **None** and select the **Ready** and **Usage** check boxes.
 - e. At the top of the Chart Options dialog box, click the **Save Options As** button, type **Lab11** in the **Chart options name** text box, and click **OK**.
 - f. Click **OK** to close the Chart Options dialog box.
 - g. Verify that the chart **View** selection is **Lab11**.
7. To collapse the chart links panel, click the << icon.
8. Scroll down to uncover the Performance Chart Legend.
 - If your display does not show the entire Performance Chart Legend, including the counter value columns, then note the order in which the counters appear in the table.
 - If necessary, scroll to the right and reduce the widths of the Rollup and Units columns to uncover the counter value columns.
9. Record the following Latest column values in the Baseline Data column of table 2.
 - Ready
 - Usage

Task 5: Import the CPU-HOG vApp

The CPU-HOG vApp is designed to consume as much processor resource as possible. The vApp consists of several workload virtual machines, each with a virtual CD-ROM drive connected to an Ultimate Boot CD ISO file. Hardware test applications on the boot CD-ROM create instant and measurable load on the host.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- ESXi local datastore name

1. In the Hosts and Clusters inventory tree, select the **Training** data center and select **Deploy OVF Template** from the **Actions** drop-down menu.
2. In the Deploy OVF Templates dialog box, configure the vApp deployment.
 - a. Under Select source, select the **Local file** radio button, click **Browse**, navigate to Desktop\Lab_files\vApp Templates\CPU-HOG and open the CPU-HOG.ovf file.
 - b. Click **Next**.
 - c. Under Review details, click **Next**.
 - d. Under Select name and folder, keep the CPU-HOG name, select the **Training** data center, and click **Next**.
 - e. Under Select a resource, select the ESXi host and click **Next**.
 - f. Under Select storage, select the ESXi local datastore, leave the virtual disk format as **Thick Provision Lazy Zeroed**, and click **Next**.
 - g. Under Ready to complete, review the vApp deployment configuration and click **Finish**.
3. In the Recent Tasks panel, monitor the deployment to completion.

The deployment takes a few minutes to complete. Several virtual machines are created and named Workload01 through Workload05.
4. Leave the CPU-HOG vApp powered off.

Task 6: Generate CPU Contention

A CPU burn-in test is started on each of the five workload virtual machines.

Student A and student B should do this task independently.

1. Limit the CPU resources available to the CPU-HOG vApp.
 - a. In the Hosts and Clusters inventory tree, select the **CPU-HOG** vApp and select **Edit Settings** from the **Actions** drop-down menu.
 - b. In the Edit vApp dialog box, under Deployment, expand the **CPU resources** section.
 - c. Find the Reservation type setting and deselect the **Expandable** check box.
 - d. Verify that Limit is set to **5000 MHz**.
 - e. Click **OK**.
2. In the middle pane, select **Power On** from the **Actions** drop-down menu.
3. In the Recent Tasks pane, monitor the power on operations to completion.

Five workload virtual machines are powered on simultaneously.

4. In the Hosts and Clusters inventory tree, expand the **CPU-HOG vApp** and select the **Workload01** virtual machine.
5. Start a CPU burn-in on a workload virtual machine.
 - a. In the middle pane, select **Open Console** from the **Actions** drop-down menu.
In the console output, you see repeated failed attempts to boot from disk.
 - b. Click anywhere on the console window and press Enter to interrupt the boot attempts to load the **Ultimate Boot CD** menu.
 - c. Use the arrow keys and Enter keys to select **Mainboard Tools > CPU Tests > CPU Burn-in V1.00**.
The exact keystroke sequence is Enter, down arrow, Enter, down arrow, and Enter
 - d. After the burn-in utility is running, press Ctrl+Alt to release the mouse focus and close the console tab.
6. Repeat steps 5a to 5d for all remaining workload virtual machines (workload02 through workload05).
On completion, all five workload virtual machines run a continuous CPU burn-in.

Task 7: Record Statistics for Case 1: Single Thread and Single vCPU

You record three sets of statistics for the first test case.

Student A and student B should do this task independently.

1. After 30 seconds of statistic collection, record `resxtop` counter values.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
The workload virtual machines are included in the output.
 - b. Record the following Linux01 counter values in the Case 1 column of table 1.
 - %USED
 - %SYS
 - %RDY
2. Record advanced chart counter values.
 - a. Switch to the Firefox window.
 - b. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine.
 - c. In the middle pane, verify that the chart **View** is **Lab 11** and correct the selection if necessary.

- d. Scroll down to uncover the Performance Chart Legend counter value columns.
 - e. Record the following Latest column values in the Case 1 column of table 2.
 - Ready
 - Usage
3. Record test script counter values.
- a. In the Firefox window, click the **Linux01** console tab.
 - b. If the Linux01 console is closed, open the tab.
 - c. Record the following counter values reported by the test script in the Case 1 column of table 3.
 - operations per minute (opm)
 - round-trip total average in milliseconds (rt_tot_avg_msec)
- The counter values are reported with each iteration that the test script performs. Use the counters reported in the last iteration.
4. Select the terminal window and press Ctrl+C to stop the test script.

Task 8: Run a Single-Threaded Program on a Virtual Machine with Two vCPUs

You configure the second case parameters and restart the test script.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
1. In the Firefox window, close the Linux01 console tab.
 2. Shut down the Linux01 virtual machine.
 - a. Select **Shut Down Guest OS** from the **Actions** drop-down menu.
 - b. When prompted, click **Yes** to confirm the shutdown.
 - c. Wait for the running indicator to be removed from the Linux01 virtual machine icon in the inventory tree.

You can click the refresh icon, located to the left of the logged in user name, to force a manual refresh of the inventory tree.



3. Add a second vCPU to the Linux01 virtual machine.
 - a. In the middle pane, click the **Manage** tab and click the **Settings** button.
 - b. Select the **VM Hardware** link and click the **Edit** button.
 - c. On the **Virtual Hardware** tab, select **2** from the **CPU** drop-down menu and click **OK** to commit the VM hardware changes.
 - d. In the Recent Tasks panel, monitor the reconfiguration task to completion.
4. Power on the Linux01 Virtual Machine and open a console window.
 - a. Select **Power On** from the **Actions** drop-down menu and select **Open Console** after the power-on task completes.
 - b. Log in as root with the standard lab password.
5. Restart the test program.
 - a. In the Linux01 console, right-click the desktop and select **Open Terminal**.
 - b. Restart the test program.

```
./starttest1
```

This script generates database operations to a medium-size database. The number of threads is set to 1. The script must run uninterrupted.

Task 9: Record Statistics for Case 2: One Thread and Two vCPUs

You record three sets of statistics for the second test case.

Student A and student B should do this task independently.

1. After 30 seconds of statistic collection, record the `resxtop` counter values.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. Record the following Linux01 counter values in the Case 2 column of table 1.
 - %USED
 - %SYS
 - %RDY
2. Record advanced chart counter values.
 - a. Switch to the Firefox window and click the **vSphere Web Client** tab.
 - b. In the middle pane, click the **Monitor** tab.
 - c. Click the chart **refresh** icon that appears to the right of the **View** button, above the chart.

- d. Scroll down to uncover the Performance Chart Legend counter value columns.
 - e. Record the following Latest column values in the Case 2 column of table 2.
 - Ready
 - Usage
3. Record test script counter values.
- a. In the Firefox window, click the **Linux01** console tab.
 - b. Record the following counter values reported by the test script, in the terminal window in the Case 2 column of table 3.
 - `opm`
 - `rt_tot_avg_msec`
- The counter values are reported with each iteration that the test script performs. Use the counters reported in the last iteration.
4. Select the terminal window and press Ctrl+C to stop the test script.

Task 10: Run a Dual-Threaded Program in a Dual-vCPU Virtual Machine

You configure case 3 by running a two-threaded test program on a virtual machine with two vCPUs.

Student A and student B should do this task independently.

1. In the terminal window, start the two-threaded test program.

```
./starttest2
```

This script generates database operations to a medium-size database. The number of threads is set to 2. The script must run continuously.

Task 11: Record Statistics for Case 3: Two Threads and Two vCPUs

Record three sets of statistics for the final test case.

Student A and student B should do this task independently.

1. After 30 seconds of statistics collection, record the `resxtop` counter values.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. Record the following Linux01 counter values in the Case 3 column of table 1.
 - `%USED`
 - `%SYS`
 - `%RDY`

2. Record advanced chart counter values.
 - a. Switch to the Firefox window and click the **vSphere Web Client** tab.
 - b. Click the chart **refresh** icon.
 - c. Scroll down to uncover the Performance Chart Legend counter value columns.
 - d. Record the following Latest column values in the Case 3 column of table 2.
 - Ready
 - Usage
3. Record the test script counter values.
 - a. In the Firefox window, click the **Linux01** console tab.
 - b. Record the following counter values reported by the test script in the terminal window in the Case 3 column of table 3.
 - opm
 - rt_tot_avg_msec

The counter values are reported with each iteration that the test script performs. Use the counters reported in the last iteration.
4. Leave the test program running.

Task 12: Analyze the Test Results

You analyze the captured statistics and document your conclusions.

Student A and student B should do this task independently.

1. Review the statistics that you recorded.
2. Record conclusions that you can draw from the data. _____

Task 13: Clean Up for the Next Lab

Perform these actions to prepare for the next lab. The next lab is directly dependent on the state of the sandbox at this point.

Student A and student B should do this task independently.

1. Leave all windows and tabs open.
2. Leave all virtual machines running (including the CPU-HOG workloads).
3. Leave the test program running in the Linux01 virtual machine.

The current state of the lab environment is used in the next lab.

Table 1: resxtop: %USED, %SYS, and %RDY

resxtop Counters	Baseline Data	Case 1	Case 2	Case 3
%USED				
%SYS				
%RDY				

Table 2: Advanced Chart: Usage and Ready

vSphere Web Client counters	Baseline Data	Case 1	Case 2	Case 3
Usage				
Ready				

Table 3: Test Program Counters: opm and rt_tot_avg_msec

Test Virtual Machine Counters	Case 1	Case 2	Case 3
opm			
rt_tot_avg_msec			

Lab 12

Diagnosing CPU Performance Issues

Objective: Use a performance troubleshooting checklist to detect possible CPU performance problems

In this lab, you will perform the following tasks:

1. Configure Advanced Performance Charts
2. Check for CPU Saturation on an ESXi host
3. Check for CPU Saturation or Low CPU Utilization on a Virtual Machine
4. Check SMP Status on a Virtual Machine
5. Summarize the Results
6. Clean Up for the Next Lab

Performing this lab requires successful completion of the previous lab of the course. If you have not completed the previous lab, please contact the instructor for guidance.

Task 1: Configure Advanced Performance Charts

You configure an advanced CPU performance chart for the VMware® ESXi™ host and another CPU performance chart for the test virtual machine.

Student A and student B should do this task independently.

1. In the Firefox window, click the **vSphere Web Client** tab.
2. In the Hosts and Clusters inventory tree, select the ESXi host.
3. In the middle pane, click the **Monitor** tab and click the **Performance** button.
4. Select the **Advanced** link and collapse the links panel by clicking the << icon.
5. Click the chart **View** menu, select **CPU**, and click the **Chart Options** link.
6. Configure and save the ESXi host CPU performance chart.
 - a. For Timespan, leave **Real-time** selected
 - b. In the Select object for this chart panel, click the **None** button and select the ESXi host check box.
 - c. For the Chart Type, leave **Line Graph** selected.
 - d. In the Select counters for this chart panel, click the **None** button and select the **Usage** check box.
 - e. At the top of the Chart Options dialog box, click the **Save Options As** button, type **Lab-12a** in the **Chart options name** text box, and click **OK**.

CAUTION

Save the chart options as instructed. If the chart resets to a default set of options, you can restore the chart by loading the saved options using the Chart Options dialog box.

- f. Click **OK** to close the Chart Options dialog box.
7. Verify that chart View selection is Lab-12a.
 8. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine.
 9. In the middle pane, click the **Monitor** tab and click the **Performance** button.
 10. Select the **Advanced** link and collapse the links panel by clicking the << icon.
 11. Click the chart **View** button, select **CPU**, and click the **Chart Options** link.
 12. Configure and save the virtual machine CPU performance chart.
 - a. For Timespan, leave **Real-time** selected.

- b. In the Select object for this chart panel, click the **None** button and select the **Linux01** check box.
 - c. For the Chart Type, leave **Line Graph** selected.
 - d. In the Select counters for this chart panel, click the **None** button and select the **Ready** and **Usage** check boxes.
 - e. At the top of the Chart Options dialog box, click the **Save Options As** button, type **Lab-12b** in the **Chart options name** text box, and click **OK**.
 - f. Click **OK** to close the Chart Options dialog box.
13. Verify that the chart View selection is Lab-12b.

Task 2: Check for CPU Saturation on an ESXi host

You examine advanced performance chart and `resxtop` CPU statistics to determine if the ESXi host is experiencing CPU saturation.

Student A and student B should do this task independently.

1. Record the advanced performance chart statistics.
 - a. In the Hosts and Clusters inventory tree, select the ESXi host.
 - b. Verify that the chart View selection is Lab-12a and correct the selection if necessary. Perform this verification step each time to switch back to view the ESXi host chart.
 - c. Scroll down to uncover the Performance Chart Legend counter value columns.
 - d. Record the column values for Usage.
 - Maximum (Usage) _____
 - Average (Usage) _____

If the Average column is not displayed, resize one or more of the visible columns. The Average column is always the last column in the Legend and appears when a column resize occurs.

2. Record the `resxtop` statistics.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. In the section above the per-object statistics table, find PCPU USED (%).
 - c. Record the PCPU USED (%) AVG value. _____

3. Use the gathered statistics to answer the questions.

Q1. Is the average CPU usage greater than 75 percent?

Q2. Is the maximum (peak) greater than 90 percent?

The host is experiencing CPU saturation if the answer to either question is Yes.

Q3. Is the host experiencing CPU saturation?

Task 3: Check for CPU Saturation or Low CPU Utilization on a Virtual Machine

You examine the advanced performance chart and `resxtop` CPU statistics to determine if the test virtual machine is experiencing CPU saturation.

Student A and student B should do this task independently.

1. Record advanced performance chart statistics.
 - a. Switch to the Firefox window.
 - b. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine.
 - c. Verify that the chart **View** selection is Lab-12b and correct the selection if necessary.
 - d. Scroll down to uncover the Performance Chart Legend counter value columns.
 - e. Record the column values for Usage.
 - Maximum (Usage) _____
 - Average (Usage) _____
2. Record the `resxtop` virtual machine statistics.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. In the `resxtop` output, find the Linux01 virtual machine statistics.
 - c. Record the %USED counter value. _____

3. Use the gathered statistics to answer the low CPU utilization questions.

Q1. Is the Used:Average (performance chart) or %USED (resxtop) value greater than 75 percent?

If the answer is yes, CPU utilization on the virtual machine is low. A low usage level might indicate a performance problem. (However, the use level might also indicate that the virtual machine is not experiencing a lot of activity at the time of the test.)

Q2. Do you see a significant difference between the %USED reported by resxtop and the Used Average reported by the advanced chart?

Q3. Can you explain why these two tools are reporting significantly different statistics for the same virtual machine and metric?

Q4. Without further investigation, can an administrator determine if the virtual machine is experiencing CPU saturation?

4. Record `resxtop` vCPU statistics.

a. Access the expand/rollup prompt by typing `e`.

The expand/rollup prompt appears above the top-left corner of the statistics table.

b. At the expand/rollup prompt, type the Linux01 GID value and press Enter.

The GID value for each object in the statistics table appears in the column to the left of the object name.

```
Group to expand/rollup (gid): 7008578
  ID      GID  NAME      NWLD
  7008578 7008578 Linux01      8
```

c. In the child object statistics, find the two lines named `vmx-vcpu-0:Linux01` and `vmx-vcpu-1:Linux01`.

These lines represent the two vCPUs configured for the Linux01 guest.

- d. Record the %USED value for each vCPU.
 - vmx-vcpu-0 %USED _____
 - vmx-vcpu-1 %USED _____
5. Use the gathered statistics to answer the following questions.
 - Q5. Do the %USED values for the vCPUs fluctuate around the same percentage, give or take a few percentage points?**

 - Q6. Is the Used average reported by the chart around the same range as being shown for the vCPUs in resxtop (step 1d in this task)?**

 - Q7. Can you explain what caused the original difference in values that was observed?**

 - Q8. If resxtop reports a %USED value greater than 75 percent for a virtual machine, does that indicate CPU saturation on the virtual machine?**
6. Update the Linux01 advanced performance chart to include vCPU objects.
 - a. Switch to the Firefox window.
 - b. Verify that the Chart view selection is Lab-12b and correct the selection if necessary.
 - c. Click the **Chart Options** link.
 - d. In the Select object for this chart panel, select the **0** and **1** check boxes to include the two vCPU objects in the chart output.
 - e. Use the **Save Options As** button to save the chart options as **Lab-12b**.
 - f. On the Settings Name Warning dialog box, click **Yes**.
 - g. Click **OK** to close the Chart Options dialog box.
7. Record advanced performance chart statistics for each vCPU.
 - a. Scroll down to uncover the Advanced Chart Legend.
 - b. Note which line is vCPU0 (0) and which line is vCPU1 (1), with a Measurement type of Ready.

- c. If necessary, scroll right to uncover the counter value columns.
 - d. Record the Latest column value for Ready, for each vCPU.
 - vCPU0 (Ready) Latest _____
 - vCPU1 (Ready) Latest _____
8. Record `resxtop` statistics for each vCPU.
- a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. Record the %RDY value for each vCPU.
 - `vmx-vcpu-0` %RDY _____
 - `vmx-vcpu-1` %RDY _____
9. Use the gathered statistics to answer the following questions.

Q9. Is the Ready time reported by the performance chart higher than 2,000 milliseconds for any vCPU?

Q10. Is the %RDY statistics reported by RESXTOP higher than 10 percent, for any vCPU?

If you answer yes to either question, then the virtual machine is experiencing CPU saturation.

The %RDY statistic is the percentage of time a vCPU stays in the queue while in a ready to execute mode. Any value over 10 percent should be considered as an indicator of potential saturation, with any value as high as seen today indicating significant saturation.

Task 4: Check SMP Status on a Virtual Machine

Use advanced chart and `resxtop` statistics to evaluate the status of Symmetric Multi Processors (SMP) on the test virtual machine.

Student A and student B should do this task independently.

1. Switch to the Firefox window.
2. Update the Linux01 advanced performance chart to include the Usage in MHZ counter.
 - a. Verify that the chart View selection is Lab-12b and correct the selection if necessary.
 - b. Click the **Chart Options** link.
 - c. In the Select counters for this chart panel, deselect the **Usage** check box and select the **Usage in MHZ** check box.

- d. Use the **Save Options As** button to save the chart options as Lab-12b.
 - e. On the Settings Name Warning dialog box, click **Yes**.
 - f. Click **OK** to close the Chart Options dialog box.
3. Record advanced performance chart statistics for each vCPU.
 - a. Scroll down to uncover the Performance Chart Legend.
 - b. Note which line is for vCPU0 (0) and which line is for vCPU1 (1), with a Measurement type of Usage in MHz.
 - c. If necessary, scroll right to uncover the counter value columns.
 - d. Record the Average column value for Usage in MHz, for each vCPU.
 - vCPU0 (Usage in MHz) Average _____
 - vCPU1 (Usage in MHz) Average _____
 4. Record `resxtop` statistics for each vCPU.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. Record the %USED value for each vCPU.
 - vmx-vcpu-0 %USED _____
 - vmx-vcpu-1 %USED _____
 5. Use the gathered statistics to answer the following questions.

Q1. Is the Usage In MHz Average or %USED value, for either vCPU, near or at zero?

If the answer is yes, the SMP virtual machine is using only one vCPU, otherwise the virtual machine is using both vCPUs.

Task 5: Summarize the Results

You review the statistics gathered to reach a conclusion.

Student A and student B should do this task independently.

1. Based on your observations, answer the following questions.

Q1. Is there a CPU problem on the ESXi host?

Q2. If a CPU problem exists, is it affecting the test virtual machine?

Task 6: Clean Up for the Next Lab

The next lab has some dependencies on the state of the sandbox at this point. Follow the clean up steps to minimize the amount of setup you might need to do at the start of the next lab.

Student A and student B should do this task independently.

1. Leave `resxtop` running and minimize the PuTTY (vSphere Management Assistant session) window.
2. Switch to the Firefox window.
3. Stop the CPU-HOG vApp and remove the vApp from the VMware® vCenter Server™ inventory.
 - a. In the Hosts and Clusters inventory tree, select the **CPU-HOG** vApp and select **Power Off** from the **Actions** menu.
 - b. When prompted, click **Yes** to confirm the power-off operation.
 - c. In the Recent tasks pane, monitor the power-off tasks to completion.
Click the VMware vSphere® Web Client refresh icon to update the task status.
 - d. Select **All vCenter Actions** > **Remove from inventory** from the **Actions** drop-down menu.
4. On the Confirm Remove dialog box, click **Yes**.
5. In the Firefox window, leave the **vSphere Web Client** and **Linux01** console tab open, with the test program running.

Lab 13

Monitoring Memory Performance

Objective: Use performance charts and the `resxtop` command to monitor memory performance under load

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Generate Database Activity in the Test Virtual Machine
3. Check for Overcommitment of Virtual Machine Memory
4. Configure an Advanced Performance Chart
5. Configure `resxtop` to Report Virtual Machine Memory Statistics.
6. Observe Baseline Memory Statistics
7. Import the RAM-HOG vApp
8. Start a Memory Test on Each RAM-HOG Workload
9. Record Memory Statistics
10. Clean Up for the Next Lab

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client interface, power on the virtual machine, and open the PuTTY (VMware vSphere® Management Assistant session) window.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - vSphere Management Assistant administrator user name
 - Standard lab password
 - ESXi FQDN
1. Open the vSphere Web Client if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.
 2. In the left pane, click **vCenter** and click **Hosts and Clusters**.
 3. If the Linux01 virtual machine is not powered on, select the virtual machine in the inventory tree and select **Power On** from the **Actions** drop-down menu.
 4. In the Firefox window, open the **Linux01** console tab if it is not open.
 - a. In the Hosts and Clusters inventory tree, select the Linux01 virtual machine and select **Open Console** from the **Actions** menu.
 - b. If necessary, wait for the virtual machine bootup to complete and log in as root using the standard lab password.
 5. If the PuTTY window is closed, log in to the vSphere Management Assistant and set the VMware® ESXi™ host as the target server.
 - a. On the Control Center desktop, double-click the **PuTTY** shortcut.
 - b. In the PuTTY window, double-click the **vSphere Management Assistant** session.
 - c. Log in as the vSphere Management Assistant administrator with the standard lab password.
 - d. Set the ESXi host as the target server.

```
vifptarget -s server
```

Replace *server* with the ESXi FQDN.
 - e. Maximize the PuTTY window.
 6. Switch to the Firefox window.

Task 2: Generate Database Activity in the Test Virtual Machine

You start the test program if necessary.

Student A and student B should do this task independently.

1. If necessary, click the **Linux01** console tab.
2. In the Linux01 console, if a terminal window is not running on the desktop, right-click the desktop and select **Open Terminal**.
3. Start the test program used in the previous lab if it is not running in the terminal window.
 - a. In the Linux01 console, select the terminal window.
 - b. Start the test program.

```
cd /root
```

```
./starttest2
```

This test program performs continuous database operations to a medium-size database. The number of threads is set to 2. The script must run uninterrupted.

Task 3: Check for Overcommitment of Virtual Machine Memory

Use resource allocation reports to determine if memory has been overcommitted for a virtual machine.

Student A and student B should do this task independently.

1. In the Firefox window, click the **vSphere Web Client** tab.
2. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine.
3. In the middle pane, click the **Monitor** tab and click the **Resource Allocation** button.
4. Find the Host Memory panel, on the top-right corner of the pane.
5. Select **Host Memory** and record the value for Consumed. _____
6. Find the Guest Memory panel, on the lower-left corner of the pane.
7. Record the value for Active Guest Memory. _____
8. Use the gathered statistics to answer questions.

Q1. Is the consumed host memory greater than the active guest memory?

If the consumed host memory is greater than the active guest memory, memory is not overcommitted. If the consumed host memory is less than active guest memory, then overcommitment is occurring and might cause degraded performance.

Task 4: Configure an Advanced Performance Chart

You configure an advanced performance chart that reports memory statistics relating to ballooning and swapping.

Student A and student B should do this task independently.

1. In the middle pane, on the **Monitor** tab, click the **Performance** button.
2. Click the **Advanced** link and collapse the links panel by clicking the << icon.
3. Click the char **View** button, select **Memory**, and click the **Chart Options** link.
4. Configure and save a virtual machine advanced performance chart.
 - a. For **Timespan**, leave **Real-time** selected.
 - b. In the **Select object for this chart** panel, verify that only the **Linux01** virtual machine check box is selected.
 - c. For **Chart Type**, leave **Line Graph** selected.
 - d. In the **Select counters for this chart** panel, click the **None** button and select the **Balloon**, **Swap in rate** and **Swap out rate** check boxes.
 - e. At the top of the Chart Options dialog box, click the **Save Options As** button, type **Lab-13** in the **Chart options name** text box, and click **OK**.

Save the chart options in case the advanced chart is reset for any reason.
 - f. Click **OK** to close the Chart Options dialog box.

Task 5: Configure resxtop to Report Virtual Machine Memory Statistics.

You start `resxtop`, if necessary, and configure for memory statistics.

Student A and student B should do this task independently.

1. Switch to the PuTTY (vSphere Management Assistant session) window.
2. If the `resxtop` command is not running, start `resxtop`.

```
resxtop
```
3. In `resxtop`, to view the memory statistics screen, type `m`.
4. Set a 10-second update delay.
 - a. Show the delay prompt by typing `s`.
 - b. At the delay prompt, type `10` and press Enter.

5. Filter the display virtual machine statistics only, by typing `v`.
6. Remove all statistics columns from the output table except D, H, I, J, and K.
 - a. Type `f` to access the field order screen.
 - b. For fields other than D, H, I, J, and K, if an asterisk appears to the left of the field name, press the corresponding letter to remove the asterisk.
 - c. For the D, H, I, J, and K fields, if an asterisk does not appear to the left of the field name, press the corresponding letter to add an asterisk.
 - d. Press Enter to return to the memory statistics output.

Task 6: Observe Baseline Memory Statistics

You observe advanced chart and `resxtop` counters to determine the baseline conditions.

Student A and student B should do this task independently.

1. Examine `resxtop` statistics.
 - a. In the `resxtop` output, find the Linux01 virtual machine statistics.
 - b. Verify that the MCTLSZ, MCTLTGT, SWCUR, SWTGT, SWR/s, and SWW/s values are all at or near zero.
2. Examine performance chart statistics.
 - a. Switch to the Firefox window.
 - b. Verify that the chart View selection is **Lab-13** and correct the selection if necessary.
 - c. Scroll down to uncover the Performance Chart Legend counter value columns.
 - d. Verify that the Latest column values are at or near zero and answer questions.

Q1. What does at zero or near-zero values indicate for the Balloon, Swap in rate, and Swap out rate counters?

3. Record test program statistics.
 - a. In the Firefox window, click the **Linux01** console tab.
 - b. Record the operations per minute (opm) counter value for the last test iteration.

Task 7: Import the RAM-HOG vApp

The RAM-HOG vApp is designed to consume as much memory resource as possible. The vApp consists of several workload virtual machines, each with a virtual CD-ROM drive connected to an Ultimate Boot CD ISO file. Hardware test applications on the boot CD-ROM create instant and measurable load on the host.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- ESXi local datastore name
1. In the Firefox window, click the **vSphere Web Client** tab.
 2. In the Hosts and Clusters inventory tree, select the **Training** data center and select **Deploy OVF Template** from the **Actions** drop-down menu.
 3. In the Deploy OVF Templates dialog box, configure the vApp deployment.
 - a. Under Select source, select the **Local file** radio button, click **Browse**, navigate to Desktop/Lab_files/vApp Templates/RAM-HOG, and open the RAM-HOG.ovf file.
 - b. Click **Next**.
 - c. Under Review details, click **Next**.
 - d. Under Select name and folder, keep the RAM-HOG name, select the **Training** data center, and click **Next**.
 - e. Under Select a resource, select the ESXi host and click **Next**.
 - f. Under Select storage, select the ESXi local datastore, leave the virtual disk format as **Thick Provision Lazy Zeroed**, and click **Next**.
 - g. Under Setup networks, leave VM Network selected and click **Next**.
 - h. Under Ready to complete, review the vApp deployment configuration and click **Finish**.
 4. In the Recent Tasks panel, monitor the deployment to completion.

The deployment takes a few minutes to complete. Several virtual machines are created, named Workload1 through Workload6.
 5. Leave the RAM-HOG vApp powered off.

Task 8: Start a Memory Test on Each RAM-HOG Workload

A memory test is started on each workload virtual machine that causes overcommitment of host memory.

Student A and student B should do this task independently.

1. In the Hosts and Clusters inventory tree, select the **RAM-HOG** vApp and select **Power On** from the **Actions** drop-down menu

2. In the Recent Tasks pane, monitor the power on operations to completion.

Six workload virtual machines are powered on simultaneously.

3. In the Hosts and Clusters inventory tree, drag the **Linux01** virtual machine from the data center to the **RAM -HOG** vApp.

The Linux01 virtual machine becomes a part of the vApp.

4. In the inventory tree, expand the **RAM-HOG** vApp and select the **Workload1** virtual machine.

5. Start a memory test on a workload virtual machine.

- a. In the middle pane, select **Open Console** from the **Actions** drop-down menu.

In the console output, you see repeated failed attempts to boot from disk.

- b. Click anywhere within the console window and press Enter to interrupt the boot attempts and load the **Ultimate Boot CD** menu.

- c. Use the arrow and Enter keys to select the **Mainboard Tools > Memory Tests > Memtest86+ V1.70** menu sequence.

The exact keystroke sequence is: Enter, down arrow, down arrow, Enter, down arrow, down arrow, Enter.

- d. After the memory test utility is running, press Ctrl+Alt to release the mouse focus and close the console tab.

6. Perform step 5 for each remaining workload virtual machine (workload2 through workload6).

When complete, all six workload virtual machines run a continuous memory test.

Task 9: Record Memory Statistics

You record and evaluate memory statistics with a significant load consuming ESXi host memory.

Student A and student B should do this task independently.

1. Examine and analyze performance chart statistics.
 - a. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine.
 - b. In the middle pane, click the **Monitor** tab and click the **Performance** button.
 - c. Verify that the chart View selection is **Lab-13** and correct the selection if necessary.
 - d. Scroll down to uncover the Performance Chart Legend.
 - e. If your display does not show the entire Performance Chart Legend, including the counter value columns, note the order in which the counters appear in the table.
 - f. If necessary, scroll right to uncover the counter value columns.
 - g. Use the Latest and Maximum column values for all three counters to answer questions.

Q1. Is there ballooning activity?

Q2. Is there swapping activity?

2. Compare the test program counters.
 - a. In the Firefox window, click the **Linux01** console tab.
 - b. Record the opm counter value for the last test iteration. _____
 - c. Compare the opm value recorded in task 6 (step 3) with the value recorded in the preceding step and answer the question.

Q3. Based on the two opm values, has the performance of test application degraded?

3. Switch to the PuTTY (vSphere Management Assistant session) window.

The remainder of this task is focused on analyzing the MCTLSZ, MCTLTGT, SWCUR, SWTGT, SWR/s, and SWW/s counter values.

4. Determine whether the ESXi host reached a steady state of memory activity.
 - a. For the Linux01 virtual machine, compare the values for MCTLSZ and MCTLTGT.
 - b. Determine whether the value for MCTLSZ converges with MCTLTGT. _____
 - c. For the Linux01 virtual machine, compare the values for SWCUR and SWTGT.

d. Determine whether the value for SWCUR converges with SWTGT. _____

If the counters in each set are close in value to each other, the host has reached a steady state.

5. Repeat step 4 and monitor the statistics output until the host reaches a steady state where the counters in each set are close in value to each other.
6. To determine which virtual machines do not have the balloon driver installed, examine the MCTL? value for each virtual machine.
7. Record which virtual machines have a MCTL? value of N. _____

The MCTL? field indicates the presence of a balloon driver. If the MCTL? is Y, then that virtual machine has a balloon driver installed. Otherwise, the virtual machine lacks a balloon driver.

8. To determine if the virtual machines are swapping, examine the values for SWR/s and SWW/s for each virtual machine.
9. Record which virtual machines are swapping. _____
10. Determine which virtual machines have experience degraded performance due to swapping.
 - a. To switch to the CPU screen, type lowercase **c**.
 - b. Examine the %SWPWT value for each virtual machine identified as actively swapping.
As %SWPWT exceeds 5 percent, the performance of the virtual machine degrades significantly.
 - c. Based on the %SWPWT values, record the virtual machines that are affected by swapping.

You might want to close the Linux01 VM by pressing lowercase **e**.

11. To return to the `resxtop` memory screen, type **m**.

Task 10: Clean Up for the Next Lab

The next lab is directly dependent on the state of the sandbox at this point.

Student A and student B should do this task independently.

1. In the Firefox window, leave the **vSphere Web Client** and **Linux01** tabs open.
2. In the Linux01 console, leave the terminal window open with the test program running.
3. Leave the PuTTY (vSphere Management Assistant session) window open, with `resxtop` running.
4. Leave the RAM-HOG vApp running in the inventory.
5. Leave the Linux01 virtual machine in the RAM-HOG vApp.

Lab 14

Diagnosing Memory Performance Issues

Objective: Use a troubleshooting checklist to detect possible performance problems related to memory swapping and paging

In this lab, you will perform the following tasks:

1. Generate Database Activity in the Test Virtual Machine
2. Configure Advanced Performance Charts
3. Configure resxtop to Report Virtual Machines Memory Statistics
4. Check for Active Host-Level Memory Swapping
5. Determine Which Virtual Machines Are Affected by Host-Level Memory Swapping
6. Check for Past Host-Level Swapping
7. Determine Which Virtual Machines Are Affected by Past Host-Level Swapping
8. Check for Guest Operating System Paging at the Host Level
9. Check for Guest Operating System Paging in Each Virtual Machine
10. Check for High Guest Memory Demand
11. Clean Up for the Next Lab

Performing this lab requires successful completion of the previous lab of the course. If you have not completed the previous lab, please contact the instructor for guidance.

Task 1: Generate Database Activity in the Test Virtual Machine

You start the test program if necessary.

Student A and student B should do this task independently.

1. Switch to the Firefox window and click the **Linux01** console tab.
2. In the Linux01 console, if a terminal window is not open on the desktop, right-click the desktop and select **Open Terminal**.
3. If the test program used in the previous lab is not running in the terminal window, select the terminal window and start the test program.

```
./starttest2
```

This test program performs continuous database operations to a medium-size database. The number of threads is set to 2. The script must run uninterrupted.

4. Right-click the Linux01 desktop and select Open Terminal.
A second terminal window is used to continuously capture swap information.
5. In the new terminal window, begin capturing Linux swap statistics.

```
vmstat 3
```

The *vmstat* command must run uninterrupted.

Task 2: Configure Advanced Performance Charts

You configure two different advanced performance charts to report memory statistics for the VMware® ESXi™ host and running virtual machines.

Student A and student B should do this task independently.

1. Switch to the Firefox window and click the **vSphere Web Client** tab.
2. In the Hosts and Clusters inventory tree, select the ESXi host.
3. In the middle pane, click the **Monitor** tab and click the **Performance** button.
4. Click the **Advanced** link and collapse the links panel by clicking the << icon.
5. Click the chart **View** button, select **Memory**, and click the **Chart Options** link.
6. Configure and save the first advanced performance chart.
 - a. For Timespan, leave **Real-time** selected.
 - b. For the Chart Type, select **Stacked Graph per VM** from the drop-down menu.

- c. In the Select object for this chart panel, click the **None** button and select the **Linux01** and the **Workload1** through **Workload6** check boxes.
- d. In the Select counters for this chart panel, click the **None** button and select the **Swap out rate** check box.

In this analysis, you want to observe the Swap in rate. However, stacked graph charts only report one counter at a time instead of configuring a single performance chart to report many virtual statistics.

- e. At the top of the Chart Options dialog box, click the **Save Options As** button, type **Lab-14a** in the **Chart options name** text box, and click **OK**.

Save the chart options as instructed. The options are updated at various points. You switch between different charts and a chart might reset to a default state requiring options to be reloaded.

- f. Click **OK** to close the Chart Options dialog box.
7. Configure and save a second advanced performance chart.
 - a. Click the **Chart Options** link.
 - b. For **Timespan**, leave **Real-time** selected.
 - c. For **Chart Type**, select **Line Graph** from the drop-down menu.
 - d. In the Select object for this chart panel, select the ESXi host check box.
 - e. In the Select counters for this chart panel, click the **None** button and select the **Balloon**, **Swap in rate**, **Swap out rate**, and **Swap used** check boxes.
 - f. At the top of the Chart Options dialog box, click the **Save Options As** button, type **Lab-14b** in the **Chart options name** text box, and click **OK**.
 - g. Click **OK** to close the Chart Options dialog box.

Task 3: Configure `resxtop` to Report Virtual Machines Memory Statistics

You start `resxtop` and, if necessary, configure memory statistics.

Student A and student B should do this task independently.

1. If the PuTTY (VMware vSphere® Management Assistant session) window is open with `resxtop` running, go to task 5.
1. Switch to the PuTTY (vSphere Management Assistant session) window.
2. Start `resxtop`.
`resxtop`
3. View the memory statistics screen by typing `m`.
4. Set a 10-second update delay.
 - a. To access the delay prompt, type lowercase `s`.
 - b. At the delay prompt, type `10` and press Enter.
5. To filter the display for virtual machine statistics only, type uppercase `v`.
6. Remove all statistics columns, except D, H, I, J, and K, from the output table.
 - a. Type `f` to access the field order screen.
 - b. For fields other than D, H, I, J, and K, if an asterisk appears to the left of the field name, press the corresponding letter to remove the asterisk.
 - c. For the D, H, I, J, and K fields, if an asterisk does not appear to the left of the field name, press the corresponding letter to add an asterisk.
 - d. Press Enter to return to the memory statistics output.
7. Minimize the PuTTY window.

Task 4: Check for Active Host-Level Memory Swapping

You examine advanced performance chart and `resxtop` statistics to determine if the ESXi host is actively swapping virtual machine memory.

Student A and student B should do this task independently.

1. Record advanced performance chart statistics.
 - a. Switch to the Firefox window.
 - b. Verify that the chart **View** selection is **Lab-14b** and correct the selection if necessary.
 - c. Scroll down to uncover the Performance Chart Legend.

- d. If your display does not show the entire Performance Chart Legend, including the counter value columns, then note the order in which the counters appear in the table.
 - e. If necessary, scroll right to uncover the counter value columns.
 - f. Record the Latest column values.
 - Swap in rate (Latest) _____
 - Swap out rate (Latest) _____
2. Record `resxtop` statistics.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. At the top of the `resxtop` memory screen, find the **SWAP/MB** line.

```

vma.vclass.local - PuTTY
10:42:44am up 17 days 13:27, 466
PMEM /MB: 8191 total: 1044
VMKMEM/MB: 8152 managed: 408
PSHARE/MB: 252 shared, 21
SWAP /MB: 147 curr, 149
ZIP /MB: 6 zipped, 5
MEMCTL/MB: 207 curr, 208
  
```

- c. Record the SWAP/MB > curr value. _____
3. Use the gathered statistics to answer the question.

Q1. Are any of the values greater than zero?

If the answer is yes, the ESXi host is actively swapping virtual machine memory.

Task 5: Determine Which Virtual Machines Are Affected by Host-Level Memory Swapping

Examine the Swap in rate and Swap out rate counters to determine which virtual machines are affected by active host level swapping.

Student A and student B should do this task independently.

1. Record **Swap out rate** for each virtual machine.
 - a. Switch to the Firefox window.
 - b. Click the chart **View** button and select **Lab-14a** and scroll down to uncover the Performance Chart Legend.

c. Record the Latest column value for Swap out rate, for each virtual machine. If the latest swap out rate values are all zeros, use the Maximum column values.

- Linux01 swap out rate (Latest) _____
- Workload01 swap out rate (Latest) _____
- Workload02 swap out rate (Latest) _____
- Workload03 swap out rate (Latest) _____
- Workload04 swap out rate (Latest) _____
- Workload05 swap out rate (Latest) _____
- Workload06 swap out rate (Latest) _____

2. Record `resxtop` statistics.

a. Switch to the PuTTY (vSphere Management Assistant session) window.

b. In the `resxtop` memory screen, find the SWR/S and SWW/s columns.

c. Record the SWR/S and SWW/S column values for each virtual machine.

- Linux01 SWR/s _____
- Linux01 SWW/s _____
- Workload01 SWR/s _____
- Workload01 SWW/s _____
- Workload02 SWR/s _____
- Workload02 SWW/s _____
- Workload03 SWR/s _____
- Workload03 SWW/s _____
- Workload04 SWR/s _____
- Workload04 SWW/s _____
- Workload05 SWR/s _____
- Workload05 SWW/s _____
- Workload06 SWR/s _____
- Workload06 SWW/s _____

- Use the gathered statistics to answer questions.

Q1. Are any values greater than zero?

Any virtual machine that shows a swap in rate, swap out rate, SWR/s, or SWW/s value that is greater than zero is swapping.

Q2. Is the test virtual machine being swapped?

Task 6: Check for Past Host-Level Swapping

You examine the Swap Used (advanced performance chart) and SWAP/MB (`resxtop`) counters to determine if host-level swapping has occurred in a specific timespan.

Student A and student B should do this task independently.

- Record the advanced performance chart statistics.
 - Switch to the Firefox window.
 - Click the chart **View** button and select **Lab-14b** and scroll down to uncover the Performance Chart Legend.
 - If your display does not show the entire Performance Chart Legend, including the counter value columns, then note the order in which the counters appear in the table.
 - If necessary, scroll right to uncover the counter value columns.
 - Record the Maximum column value for Swap Used. _____
- Record `resxtop` statistics.
 - Switch to the PuTTY (vSphere Management Assistant session) window.
 - At the top of the `resxtop` memory screen, find the **SWAP/MB** line.
 - Record the SWAP/MB value. _____
- Use the gathered statistics to answer the question.

Q1. Is any statistic value greater than zero?

If the answer is yes, the ESXi host has swapped virtual machine memory within the configured time range of the chart. The swapping might be an indication of potential performance problems.

Task 7: Determine Which Virtual Machines Are Affected by Past Host-Level Swapping

You examine the Swap Used (advanced performance chart) and the SWCUR (*resxtop*) counters to determine which virtual machines have been affected by host-level swapping over a period of time.

Student A and student B should do this task independently.

1. Change the Lab-14a counter from **Swap out rate** to **Swap Used**.
 - a. Switch to the Firefox window.
 - b. Click the chart **View** button and select **Lab-14a** and click the **Chart Options** link.
 - c. In the Select counters for this chart panel, select the **Swap Out** check box.
 - d. Click **OK**.
2. Record advanced chart statistics.
 - a. Scroll down to uncover the Performance Chart Legend.
 - b. If your display does not show the entire Performance Chart Legend, including the counter value columns, then note the order in which the virtual machines appear in the table.
 - c. If necessary, scroll right to uncover the counter value columns.
 - d. Record the Maximum column value for Swap Out, for each virtual machine.
 - Linux01 swap used (Maximum) _____
 - Workload01 swap used (Maximum) _____
 - Workload02 swap used (Maximum) _____
 - Workload03 swap used (Maximum) _____
 - Workload04 swap used (Maximum) _____
 - Workload05 swap used (Maximum) _____
 - Workload06 swap used (Maximum) _____
3. Record *resxtop* statistics.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. In the *resxtop* memory screen, find the SWCUR column.
 - c. Record the SWCUR column value for each virtual machine.
 - Linux01 SWCUR _____
 - Workload01 SWCUR _____
 - Workload02 SWCUR _____

- Workload03 SWRCUR _____
- Workload04 SWCUR _____
- Workload05 SWCUR _____
- Workload06 SWCUR _____

4. Use the gathered statistics to answer questions.

Q1. Has memory been swapped from any of the virtual machines in the past?

Q2. Has the Linux01 test virtual machine memory been swapped in the past?

Task 8: Check for Guest Operating System Paging at the Host Level

Examine the Balloon (advanced performance chart) and the MEMCTL/MB (`resxtop`) to determine if guest operating system paging is active at the ESXi host level.

Student A and student B should do this task independently.

- Record advanced performance chart statistics.
 - Switch to the Firefox window.
 - Click the chart **View** button and select **Lab-14b** and scroll down to uncover the Performance Chart Legend.
 - If your display is not wide enough to show the entire Performance Chart Legend, including the counter value columns, then note the order in which the counters appear in the table.
 - If necessary, scroll right to uncover the counter value columns.
 - Record the Latest column value for Balloon. _____
- Record `resxtop` statistics.
 - Switch to the PuTTY (vSphere Management Assistant session) window.
 - At the top of the `resxtop` memory screen, find the MEMCTL/MB line.
 - Record the MEMCTL/MB value. _____
- Use the gathered statistics to answer questions.

Q1. Is your host ballooning the Guest OS memory?

If the answer is no, then the hosts' memory is not in high demand.

Task 9: Check for Guest Operating System Paging in Each Virtual Machine

Student A and student B should do this task independently.

1. Change the Lab-14a counter from **Swap Used** to **Balloon**.
 - a. Switch to the Firefox window.
 - b. Click the chart **View** button, select **Lab-14a**, and click the **Chart Options** link.
 - c. In the **Select counters for this chart** panel, select the **Balloon** check box.
 - d. Click **OK**.
2. Record the **Balloon** value for each virtual machine.
 - a. Scroll down to uncover the Performance Chart Legend.
 - b. If your display does not show the entire Performance Chart Legend, including the counter value columns, then note the order in which the virtual machines appear in the table.
 - c. If necessary, scroll right to uncover the counter value columns.
 - d. Record the Latest column value for Balloon, for each virtual machine.
 - Linux01 balloon (Latest) _____
 - Workload01 balloon (Latest) _____
 - Workload02 balloon (Latest) _____
 - Workload03 balloon (Latest) _____
 - Workload04 balloon (Latest) _____
 - Workload05 balloon (Latest) _____
 - Workload06 balloon (Latest) _____
3. Record `resxtop` statistics.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. In the `resxtop` memory screen, find the MCTLSZ column.
 - c. Record the MCTLSZ column value.
 - Linux01 MCTLSZ: _____
 - Workload01 MCTLSZ: _____
 - Workload02 MCTLSZ: _____
 - Workload03 MCTLSZ _____

- Workload04 MCTLSZ: _____
- Workload05 MCTLSZ: _____
- Workload06 MCTLSZ: _____

4. Use the gathered statistics to answer questions.

Q1. Are any of the virtual machines ballooning?

Q2. Is the Linux01 test virtual machine ballooning?

If the answer is no, high demand for the ESXi host's memory is not causing performance problems. If the answer is yes, high demand for the ESXi host's memory might be causing performance problems.

5. Use the Linux `vmstat` command to determine if swapping is occurring.
- Switch to the Firefox window and click the **Linux01** console tab.
 - In the Linux01 console, select the `vmstat` terminal window and press `Ctrl+C` to stop the running command.
 - Use the terminal window scroll bars to review the `si` (swap-in) and `so` (swap-out) values and answer the question.

Q3. Is the guest operating system swapping memory?

An `si` or `so` value greater than zero indicates swapping.

6. Close the `vmstat` terminal window.

Task 10: Check for High Guest Memory Demand

You examine the Memory Usage counter (advanced performance chart) and the `MEMSZ` and `GRANT` counters (`RESXTOP`) to evaluate memory demand on a virtual machine.

Student A and student B should do this task independently.

- In the Firefox window, click the **vSphere Web Client** tab.
- Change the Lab-14a counter from **Balloon** to **Usage**.
 - Click the chart **View** button and select **Lab-14a** and click the **Chart Options** link.
 - In the **Select counters for this chart** panel, select the **Usage** check box.
 - Click **OK**.

3. Record the Usage value for each virtual machine.
 - a. Scroll down to uncover the Performance Chart Legend.
 - b. If your display does not show the entire Performance Chart Legend, including the counter value columns, then note the order in which the virtual machines appear in the table.
 - c. If necessary, scroll right to uncover the counter value columns.
 - d. If the Average column is not displayed, resize one or more visible columns so that the Average column can appear.
 - e. Use the reported Average and Maximum column values, for each virtual machine, to answer the question.

Q1. Is the average value greater than 80 percent or are there peaks > 90 percent?

If the answer is yes, high demand for the virtual machine's memory might be causing performance problems. If the answer is no, high demand for the virtual machine's memory is not present.

4. Record `resxtop` statistics.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. In the **resxtop** memory screen, find the MEMSZ and GRANT columns.
 - c. Use the MEMSZ and GRANT column values for each virtual machine to answer the question.

Q2. Is there a significant difference between the MEMSZ to GRANT values for any of the virtual machines?

The GRANT value shows the amount of memory that each virtual machine has been configured with. The MEMSZ value shows the amount of the hosts' physical memory that is actually allocated to each virtual machine.

Task 11: Clean Up for the Next Lab

Perform these steps to prepare for the next lab.

Student A and student B should do this task independently.

1. In the Hosts and Clusters inventory tree, drag the **Linux01** virtual machine from the RAM-HOG vApp to the ESXi host.
2. Verify that the Linux01 virtual machine has been moved out of the RAM-HOG vApp, The Linux01 virtual machine should appear in the Training Datacenter, between Lab15_02 and Linux02.
3. Power off and delete the RAM-HOG vApp.
 - a. In the Hosts and Clusters inventory tree, select the **RAM-HOG** vApp and select **Power Off** from the **Actions** drop-down menu.
 - b. Click **Yes** to confirm the action.
 - c. In the Recent Tasks panel, monitor the power-off operations to completion. All workload virtual machines perform a shutdown.
 - d. In the middle pane, select **All vCenter Actions** > **Delete from Disk** from the **Actions** drop-down menu and click **Yes** to confirm.
4. Revert the Linux01 virtual machine to the latest snapshot.
 - a. In the Firefox window, close the **Linux01** console tab.
 - b. In the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Revert to Latest Snapshot** from the **Actions** drop-down menu.

For upcoming labs, the Linux01 virtual machine should be configured with a single virtual CPU. A snapshot of that state is provided.
 - c. When prompted, click **Yes** to confirm the snapshot operation.
5. Stop `resxtop` and close the PuTTY (vSphere Management Assistant session) window.
 - a. Switch to the PuTTY (vSphere Management Assistant session) window.
 - b. Press Q to stop the `resxtop` program.
 - c. Close the PuTTY window and click **OK** to confirm.

The vSphere Management Assistant is not needed for the remaining labs.

Lab 15

Diagnosing VMware vSphere HA Cluster Resource Issues

Objective: Detect possible vSphere HA cluster problems

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Shut Down All Running Virtual Machines
3. Student B: Disconnect the ESXi Host from the vCenter Server Instance
4. Student A: Connect a Second ESXi Host to the vCenter Server Instance
5. Review Changes in the vSphere Web Client
6. Move Your ESXi Host to the First Problem Cluster
7. Investigate the First Cluster Issue
8. Move Your ESXi Host to the Second Problem Cluster
9. Investigate the Second Cluster Issue and Start Your First Virtual Machine
10. Student A: Start a Second Virtual Machine in the Second Cluster
11. Student B: Start a Second Virtual Machine in the Second Cluster
12. Determine the Cause of the Second Cluster Issue
13. Move Your ESXi Host Back to the Training Data Center
14. Student B: Clean Up for the Next Lab
15. Student A: Clean Up for the Next Lab

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client and revert to the latest snapshot of the Linux01 virtual machine.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Open the vSphere Web Client if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.
 - d. In the left pane, click **vCenter** and click **Hosts and Clusters**.
 2. Close all other windows and all browser tabs except the vSphere Web Client tab.
 3. If the Linux01 virtual machine is not reverted to snapshot, in the Hosts and Clusters inventory tree, select the **Linux01** virtual machine and select **Revert to Latest Snapshot** from the **Actions** drop-down menu.

For upcoming labs, the Linux01 machine should be configured with a single virtual CPU (vCPU). A snapshot of that state has been provided.

Task 2: Shut Down All Running Virtual Machines

You and your lab partner combine your resources to troubleshoot cluster issues on a single VMware® vCenter Server™ system.

Student A and student B should do this task independently.

1. In the Hosts and Clusters inventory tree, find the running virtual machines and power each down by selecting **Shut Down Guest OS** from the **Actions** menu.
2. Wait for the powered-on indicator to be removed from the virtual machines that you shut down.
3. Click the vSphere Web Client refresh button as needed.

Task 3: Student B: Disconnect the ESXi Host from the vCenter Server Instance

You and your lab partner collaborate to solve a set of VMware vSphere® High Availability cluster issues. Your VMware® ESXi™ hosts are joined to the same vCenter Server instance to facilitate the collaboration and to meet the minimum resource requirements for working with vSphere HA clusters. Student B provides an ESXi host to be joined to student A's vCenter Server instance. At the end of this lab, student B's ESXi host is returned to the original vCenter Server instance.

Student B performs this task. Student A must wait for confirmation to continue with the next task.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Migrate all virtual machines from the **dvs-Lab > pg-Production** portgroup to the VM Network switch.

Before moving the ESXi host to your lab partner's vCenter Server instance, all virtual machines must be moved to the VM Network switch. If virtual machine networking is not migrated prior to the ESXi move, the virtual machines fail to start, which might cause a problem in completing this lab.

- a. In the left pane, click the **Networking** icon.
 - b. In the Networking inventory tree, select the **dvs-Lab** distributed switch and select **Migrate VM to Another Network** from the **Actions** drop-down menu.
 - c. In the Migrate Virtual Machine Networking dialog box, leave the **Specific network** radio button selected, click the **Browse** button, select **pg-Production**, and click **OK**.
 - d. Click the Destination network **Browse** button, select **VM Network**, and click **OK**.
 - e. Under Select VMs to migrate, select the **All virtual machines** check box and click **Next**.
 - f. Click **Finish**.
 - g. In the Recent Tasks panel, monitor the migration task to completion.
2. In the Hosts and Clusters inventory tree, select the ESXi host and select **Disconnect** from the **Actions** drop-down menu.
 3. When prompted, click **Yes** to confirm the action.
 4. In the Recent Tasks panel, monitor the disconnect to completion.
 5. At the top of the vSphere Web Client interface, click the **administrator@vsphere.local** user name and select **Logout**.
 6. In the Firefox window, click the **Lab 15 Web Client** bookmark.

7. When prompted, log in to student A's vCenter Server instance as the vSphere administrator with the standard lab password.
8. In the left pane, click **vCenter** and click **Hosts and Clusters**.
9. Confirm the completion of this task to your lab partner.

Task 4: Student A: Connect a Second ESXi Host to the vCenter Server Instance

You connect a second ESXi host to meet minimum vSphere HA cluster resource requirements.

Student A performs this task. Student B must wait for confirmation to continue with the next task.

Use the following information from the class configuration handout:

- Standard lab password
 - Student B ESXi FQDN
1. In the Hosts and Clusters inventory tree, select the **Training** data center and select **Add Host** from the **Actions** drop-down menu.
 2. In the Add Host dialog box, configure settings.
 - a. Type the FQDN of student B's ESXi host in the **Host name or IP address** text box and click **Next**.
 - b. Under Connection settings, type **root** for the user name, type the standard lab password, and click **Next**.
 - c. When prompted, click **Yes** to accept the certificate alert.
 - d. Under Host summary, review the host details and click **Next**.
 - e. Under Assign license, click the **VMware vSphere 5 Enterprise Plus** license key radio button and click **Next**.
 - f. Under Lockdown mode, click **Next**.
 - g. Under VM location, select the **Training** data center and click **Next**.
 - h. Under Ready to complete, review the configuration details and click **Finish**.
 3. In the Recent Tasks panel, monitor the add host action to completion.
 4. Confirm the completion of this task to your lab partner.

Task 5: Review Changes in the vSphere Web Client

As a result of being attached to the same vCenter Server instance, the virtual machines hosted on esxi02.vclass.local undergo a minor name change.

Student A and student B should do this task independently.

1. In the vSphere Web Client, click the **Refresh** icon.
2. In the Hosts and Clusters inventory tree, verify that both ESXi hosts appear under the Training data center.
3. Under the student B ESXi host, verify that each virtual machine name now includes a (2) suffix.

For the remainder of this lab, student A continues to work with the esxi01 host and its virtual machines. Student B continues to work with the esxi02 host and its virtual machines. At no time are students asked to interact with hosts or virtual machines not already assigned to them since the start of the class.

Task 6: Move Your ESXi Host to the First Problem Cluster

You move your assigned ESXi host to the first vSphere HA cluster.

Student A and student B should do this task independently and wait for confirmation from their partner before continuing with the next task. Both ESXi hosts should be moved to the first cluster before continuing the lab.

Use the following information from the class configuration handout:

- ESXi FQDN
1. In the Hosts and Clusters inventory tree, expand the **Lab-15, Use When Instructed** folder. Two cluster items appear under the expanded folder.
 2. Select **Cluster-1** and select **Move Hosts into Cluster** from the **Actions** drop-down menu.
 3. In the Move Hosts into Cluster dialog box, select the check box next to your assigned ESXi host and click **OK**.
 4. Select the **Create a new resource pool for this host's virtual machines and resource pools** radio button, keep the default resource pool name, and click **OK**.
 5. In the Recent Tasks panel, monitor the operation to completion.
 6. Expand the **Cluster-1** item and verify that your ESXi host and a corresponding resource pool appear.

Each host has an associated resource pool named *Grafted from host_fqdn*.

7. Coordinate completion of this task with your lab partner.
Continue to the next task only when both ESXi hosts are moved into Cluster-1.

Task 7: Investigate the First Cluster Issue

You determine the reasons for virtual machine power-on failure in the first vSphere HA cluster.

Student A and student B coordinate efforts during this task to start virtual machines in a specific sequence to discover issues with the vSphere HA resource configuration. Results might differ if virtual machines are powered on or if other actions are performed in the wrong order.

Use the following information from the class configuration handout:

- ESXi FQDN
1. In the Hosts and Clusters inventory tree, select **Cluster-1**.
 2. In the middle pane, click the **Summary** tab.
 3. Record the configuration values that are found in the Cluster Resources panel and the vSphere HA panels.
 - Total Processors _____
 - Total CPU Resources _____
 - Total Memory _____
 - CPU Failover Threshold _____
 - Memory Failover Threshold _____
 - Based on the configuration, which admission control policy is enabled _____
 4. In the Hosts and Clusters inventory tree, expand the resource pool associated with your ESXi host.
 5. In your host's resource pool, select the **Lab15_01** virtual machine, and select **Power On** from the **Actions** drop-down menu.
 6. In the Recent Tasks panel, monitor the power on action to completion.
 7. In the Hosts and Clusters inventory tree, select **Cluster-1**.
 8. Review with your lab partner the information that you recorded earlier and answer questions together.

Q1. Why were both machines allowed to successfully power on?

Q2. Based on resources consumed by the two running virtual machines, what happens when the next virtual machine attempts to start?

Q3. Looking at the resources consumed and given that the two virtual machines started so far are configured identically, which resource becomes depleted if another copy of the virtual machine is started?

9. Verify that you and your lab partner are ready to perform the next steps.

Continue only when both team members are ready to proceed.

10. In your host's resource pool, select the **Lab15_02** virtual machine and select **Power On** from the **Actions** drop-down menu.

The virtual machine fails to power on.

11. Record the error message that you receive. _____

12. Close the error message window.

13. Review the virtual machine resource configuration.

a. In the Hosts and Clusters inventory tree, select the **Lab15_01** virtual machine in your host resource pool.

b. In the middle pane, click the **Monitor** tab and click the **Resource Allocation** button.

c. Record the information that is found in the Host CPU panel and the Host Memory panel.

- CPU Reservation _____

- Memory Reservation _____

14. Review the available cluster resources.

a. In the Hosts and Clusters inventory tree, select **Cluster-1**.

b. In the middle pane, click the **Monitor** tab and click the **Resource Allocation** button.

c. Record the information by clicking the **CPU** and **Memory** links.

- CPU: Available Capacity _____

- Memory: Available Capacity _____

15. Review with your lab partner the resource allocation values that you recorded and answer questions together.

Q4. Did both Lab15_02 virtual machines fail to start?

Q5. What was the error message that was displayed?

- Q6. Were both resources (CPU and Memory) too low to have allowed the first Lab15_02 virtual machine to start?**
- Q7. For the first Lab15_02 virtual machine to be started, which resource (CPU or Memory) was too low to allow the virtual machine to start?**
- Q8. What are the possible solutions to the problem, given that starting all four virtual machines is a requirement?**

16. Instruct your ESXi host to enter maintenance mode.
- For each running virtual machine in your host resource pool, select the virtual machine and select **Shut Down Guest OS** from the **Actions** drop-down menu.
 - On the Confirm Shutdown dialog box, click **Yes**.
 - Monitor the shutdown actions until all virtual machines are powered off.
 - In the Hosts and Clusters inventory tree, select your ESXi host and select **Enter Maintenance Mode** from the **Actions** drop-down menu.
 - In the Confirm Maintenance Mode dialog box, deselect the **Move Powered-off and suspended virtual machines to other hosts in the cluster** check box and click **OK**.
If you do not deselect this check box, your virtual machines might be migrated to your lab partner's ESXi host.
17. After your host enters maintenance mode, drag the host from Cluster-1 to the Training data center.
The host resource pool remains under Cluster-1.
18. Close any error or warning windows that appear.

Task 8: Move Your ESXi Host to the Second Problem Cluster

You move your ESXi host to the second preconfigured vSphere HA cluster.

Student A and student B should do this task independently and wait for confirmation before continuing to the next task.

Use the following information from the class configuration handout:

- ESXi FQDN
1. In the Hosts and Clusters inventory tree, select **Cluster-2**.
 2. In the middle pane, select **Move Hosts into Cluster** from the **Actions** drop-down menu.
 3. In the Move Hosts into Cluster dialog box, select the check box next to your assigned ESXi host and click **OK**.
 4. Select the **Create a new resource pool for this host's virtual machines and resource pools** radio button, keep the default resource pool name, and click **OK**.
 5. In the Recent Tasks panel, monitor the operation to completion.
 6. Expand **Cluster-2** and verify that your ESXi host and a corresponding resource pool appear. Each host has an associated resource pool named *Grafted from host-fqdn*.
 7. Select your ESXi host and select **Exit Maintenance Mode** from the **Actions** drop-down menu.
 8. Coordinate the completion of this task with your lab partner.
Continue only when both ESXi hosts have been moved into Cluster-2.

Task 9: Investigate the Second Cluster Issue and Start Your First Virtual Machine

You determine reasons for virtual machine power-on failure in the second vSphere HA cluster.

Student A and student B coordinate efforts during this task to start virtual machines in a specific sequence to discover issues with the vSphere HA resource configuration.

Use the following information from the class configuration handout:

- ESXi FQDN

Coordinate the sequence of actions with your lab partner. Results might differ if virtual machines are powered up or if other actions are performed in the wrong order.

1. In the Hosts and Clusters inventory tree, select **Cluster-2**.
2. In the middle pane, click the **Summary** tab.

3. Use the vSphere HA panel to answer the question.

Q1. Which admission control policy is enabled?

4. In the Hosts and Clusters inventory tree, expand the resource pool associated with your ESXi host.
5. In your hosts' resource pool, select the **Win01** virtual machine and select **Power On** from the **Actions** drop-down menu.
6. In the Recent Tasks panel, monitor the power on action to completion.

The virtual machine powers on successfully.

7. Review the resource configuration of the next virtual machine to be started.
 - a. Select the **Win02** virtual machine in your host resource pool.
 - b. In the middle pane, click the **Monitor** tab and click the **Resource Allocation** button.
 - c. Record the information from the Host CPU panel and the Host Memory panel.
 - CPU Reservation _____
 - Memory Reservation _____
 - Memory Configured _____

8. Review available cluster resources.

- a. In the Hosts and Clusters inventory tree, select **Cluster-2**.
- b. In the middle pane, click the **Monitor** tab and click the **Resource Allocation** button.
- c. Record the information from the CPU panel and the Memory panel.
 - CPU: Available Capacity _____
 - Memory: Available Capacity _____

9. Review the resource allocation values that you have recorded with your lab partner, and answer the question together.

Q2. Based on resource availability only, do you expect the Win02 virtual machines to be allowed to power up?

Task 10: Student A: Start a Second Virtual Machine in the Second Cluster

Two virtual machine instances are running in the cluster: Win01 and Win01(2). Student A powers on an additional virtual machine, Win02, and records observations.

Student A performs this task and reports completion to student B. Student B must wait for the confirmation.

Use the following information from the class configuration handout:

- ESXi FQDN
1. In your host resource pool, select the **Win02** virtual machine and select **Power On** from the **Actions** drop-down menu.
The virtual machine powers on successfully.
 2. In the Recent Tasks panel, monitor the power-on action to completion.
 3. In the Hosts and Clusters inventory tree, select **Cluster-2**.
 4. In the middle pane, click the **Summary** tab.
 5. Record the warning message displayed on the **Summary** tab, in the yellow box. _____
 6. In the warning box, click the **Reset to Green** link.
 7. Inform your lab partner that you have completed this task.

Task 11: Student B: Start a Second Virtual Machine in the Second Cluster

Two virtual machine instances are running in the cluster, Win01 and Win01(2). Student B powers on an additional virtual machine, Win02(2), and records observations.

Student B performs this task and report completion to student A. Student A must wait for the confirmation.

Use the following information from the class configuration handout:

- ESXi FQDN
1. In your host resource pool, select the **Win02** virtual machine and select **Power On** from the **Actions** drop-down menu.
The virtual machine does not power on.
 2. Record the error message that you receive. _____
 3. Close the error message window.

4. In the Hosts and Clusters inventory tree, select **Cluster-2**.
5. Inform your lab partner that you have completed this task.

Task 12: Determine the Cause of the Second Cluster Issue

You compare observations and determine the cause of the warning and error messages.

Student A and student B coordinate efforts during this task to complete investigation of the cluster issue.

1. Discuss with your lab partner the error or warning message you received when attempting to power on your Win02 virtual machine and answer questions together.

Q1. Student A's Win02 virtual machine was successfully powered on, but a warning message was displayed. What does the warning mean?

Q2. Student B's Win02 virtual machine failed to power on and an error message was displayed. What does the error mean?

2. Review with your lab partner the summary tab information for Cluster-2 and answer the question together.

Q3. Is the cause of the problem insufficient failover capacity? Why or why not?

3. Review with your lab partner the Cluster-2 resource allocation report by selecting **Monitor > Resource Allocation** and answer the question together.

Q4. Is the cause of the problem due to resources that might have been incorrectly reserved? Why or why not?

4. In the middle pane, on the **Monitor** tab, click the **vSphere HA** button.

You might need to scroll the button row to uncover the vSphere HA button.

5. Review the vSphere HA summary report with your partner, particularly the Advanced Runtime Info panel, and answer questions together.

Q5. What is the slot size?

Q6. Is the slot size large enough to accommodate each of the virtual machines to be powered on in Cluster-2, based on the virtual machine configuration?

Q7. A total of four slots were created based on the cluster resources available and the static slot size. When Student A powered on the third virtual machine, how did that action affect cluster failover capacity?

Q8. What is preventing the fourth virtual machine from being powered on?

Q9. What are possible solutions to the problem?

6. Review the event record that was generated when student A powered on the third virtual machine in the cluster.
- In the middle pane, on the **Monitor** tab, click the **Events** button.
 - In the events list, scroll down and find the first event that matches the following parameters.
 - Type: Error
 - Description: Insufficient resources to satisfy
 - Select the event and scroll down to read the event details.

Task 13: Move Your ESXi Host Back to the Training Data Center

The vSphere HA cluster troubleshooting is complete. The ESXi hosts must be moved back to the Training data center to prepare for the next labs.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- ESXi FQDN
1. Put your ESXi host in maintenance mode.
 - a. Select each running virtual machine in your resource pool and select **Shut Down Guest OS** from the **Actions** drop-down menu.
 - b. On the Confirm Shut Down dialog box, click **Yes**.
 - c. Monitor the shut down actions until all virtual machines are powered off.
 - d. Select your ESXi host and select **Enter Maintenance Mode** from the **Actions** drop-down menu.
 - e. In the Confirm Maintenance Mode dialog box, deselect the **Move Powered-off and suspended virtual machines to other hosts in the cluster** check box and click **OK**.

If the check box is not deselected, your virtual machines are migrated to your lab partners' ESXi host and must be migrated back before continuing the lab.
 2. Drag your ESXi host from Cluster-2 to the Training data center.

The host resource pool remains under Cluster-2.
 3. Close any error or warning windows that appear.
 4. Select your ESXi host and select **Exit Maintenance Mode** from the **Actions** drop-down menu.

Task 14: Student B: Clean Up for the Next Lab

The student B host is disconnected and returned to the student B vCenter Server instance.

Student B performs this task. Student A can go to the next task.

Use the following information from the class configuration handout:

- vSphere administrator user name
- Standard lab password
- ESXi FQDN

1. Disconnect your ESXi host from the student A vCenter Server instance.
 - a. In the Hosts and Clusters inventory tree, select the your ESXi host and select **Disconnect** from the **Actions** drop-down menu.
 - b. When prompted, click **Yes** to confirm host disconnection.
 - c. Inform your lab partner that your ESXi host is removed.
2. Log in to your own vCenter Server instance.
 - a. In the Firefox window, click the **vSphere Web Client** tab to log in to your vCenter Server instance.
 - b. Log in as the vSphere administrator with the standard lab password.
3. Reconnect your ESXi host to your vCenter Server instance.
 - a. In the left pane, click **vCenter** and click **Hosts and Clusters**.
 - b. In the Hosts and Clusters inventory tree, select the disconnected host and select **Connect** from the **Actions** drop-down menu.
 - c. When prompted, click **Yes** to confirm host connection.
 - d. In the Recent Tasks panel, monitor the host action to completion.
4. If the Add Host wizard opens, complete the wizard.
 - a. On the Name and location page, click **Next**.
 - b. On the Connection settings page, log in as root with the standard lab password.
 - c. On the Security Alert dialog box, click **Yes**.
 - d. On the Host summary page, click **Next**.
 - e. On the VM location page, click **Next**.
 - f. On the Ready to complete page, click **Finish**.

Your virtual machine names include the (2) suffix for the remainder of the course. For all remaining labs, when instructed to interact with a virtual machine, add the (2) suffix. For example, if a lab instruction asks you to power on Win02, you power on Win02 (2). If you want, you can rename the virtual machines now to remove the (2) suffix.

5. Migrate all virtual machines from the VM Network switch to the **dvs-Lab > pg-Production** portgroup.

Before moving the ESXi host to your lab partner's vCenter Server instance, all virtual machines must be moved to the VM Network switch. If virtual machine networking is not migrated prior to the ESXi move, the virtual machines will fail to start, causing an problem in completing this lab.

- a. In the left pane, click the **Networking** icon.

- b. In the Networking inventory tree, select the **dvs-Lab** distributed switch and select **Migrate VM to Another Network** from the **Actions** pull-down menu.
 - c. In the Migrate Virtual Machine Networking dialog box, leave the **Specific network** radio button selected, click the **Browse** button, select **VM Network**, and click **OK**.
 - d. Click the Destination network **Browse** button, select **pg-Production** and click **OK**.
 - e. Under Select VMs to migrate, select the **Linux01**, **Linux02**, **Win01**, and **Win02** check boxes and click **Next**.
 - f. Click **Finish**.
6. In the Recent Tasks panel, monitor the migration task to completion.

Task 15: Student A: Clean Up for the Next Lab

Student A cleans up the vCenter Server inventory and prepares for the next lab.

Use the following information from the class configuration handout:

- Student B ESXi FQDN
1. Wait for your lab partner to confirm disconnection of the student B ESXi host.
 2. In the Hosts and Clusters inventory tree, verify that the student B ESXi host is disconnected and remove the host from your vCenter Server inventory.
 - a. Select the student B ESXi host and select **All vCenter Actions > Remove From Inventory** from the **Actions** drop-down menu.
 - b. On the Remove Host dialog box, click **Yes**.
 3. Remove the **Lab-15, Use When Instructed** folder, and the clusters and the resource pools that it contains, from the vCenter Server inventory.
 - a. Select the **Lab-15, Use When Instructed** folder and select **All vCenter Actions > Remove from Inventory** from the **Actions** drop-down menu.
 - b. On the Confirm Remove dialog box, click **Yes**.

Lab 16

Host Profiles

Objective: Use host profiles and manage compliance

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Create and Export a Host Profile
3. Import a Host Profile
4. Attach an ESXi Host to the Imported Host Profile
5. Run an Initial Compliance Check
6. Perform an Initial Remediation
7. Introduce a Configuration Drift
8. Run a Compliance Check and Remediate the Configuration Drift
9. Introduce a Second Configuration Drift
10. Run a Compatibility Check and Try to Remediate the Host
11. Detach the Host Profile and Exit Maintenance Mode

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client if it is not open.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Open the vSphere Web Client if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.
 - d. In the left pane, click **vCenter** and click **Hosts and Clusters**.

All virtual machines should be in a powered-off state, after completing the previous lab.

2. In the Hosts and Clusters inventory tree, select each running virtual machine, if any and select **Shut Down Guest OS** from the **Actions** menu.

Task 2: Create and Export a Host Profile

The host profile is a configuration template that is applied to any or all hosts in a cluster to verify and enforce specific configuration rules. Normally, a host profile has a reference host. In this lab, each student exports a profile for importation by the lab partner. The imported profile lacks a reference host.

Student A and student B should do this task independently, confirming the exportation of the host profiles.

Use the following information from the class configuration handout:

- Host profile export name
1. In the vSphere Web Client interface, click the **Home** icon.
 2. In the middle pane, on the **Home** tab, under **Monitoring**, click **Host Profiles**.



3. Extract a host profile from an ESXi host.
 - a. In the Objects panel, click the green plus symbol icon.
 - b. In the Extract Host Profile dialog box, click the ESXi host radio button and click **Next**.
 - c. Under Name and Description, type **Local-Profile** in the **Name** text box and click **Next**.
 - d. Under Ready to complete, click **Finish**.
 - e. In the Recent Tasks panel, monitor the task to completion.
4. In the Objects list, select the new profile and select **All vCenter Actions > Export Host Profile** from the **Actions** drop-down menu.
5. When prompted, click **Save**.
6. Navigate to the `Desktop/Lab_files/Common` folder and save the profile using the export filename specified in the lab configuration handout.
7. Confirm to your lab partner that your profile has been exported.

Task 3: Import a Host Profile

Because the student A and student B VMware® vCenter Server™ instances are configured nearly identically, host profiles can be easily imported and exported.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Host profile import name
1. Wait for your lab partner to confirm that a host profile has been exported for you.
Alternately, you can use the next steps to browse to the folder and check if the file has been created.
 2. In the row of icons above the Objects list, click the **Import Host Profile** icon.



3. In the Import Host Profile dialog box, import the file.
 - a. Click the **Browse** button, navigate to the `Desktop/Lab_files/Common` folder, and select the import file specified in the lab configuration handout.
 - b. Type **Imported-Profile** in the **Name** text box.
 - c. Click **OK**.

Task 4: Attach an ESXi Host to the Imported Host Profile

Hosts and clusters can be attached or detached from a host profile in the host profiles view, or in the Hosts and Clusters inventory.

Student A and student B should do this task independently.

1. In the Objects list, click the **Imported-Profile** link to navigate to that object and click the **Summary** tab.

2. Read the error message displayed in the yellow box.

An imported host profile is not inherently compatible with any local VMware® ESXi™ host because the original reference host does not exist in the vCenter Server inventory. No host exists that can be modified to update the associated host profile template in this vCenter Server instance. The host profile is valid and can be applied without a reference host defined.

3. Click the **Manage** tab and click the **Settings** button.

You can review and edit the comprehensive list of configuration settings that defines the host profile.

4. At the top of the inventory tree, click the back button labeled **Host Profiles**.

5. In the Objects list, select the **Imported-Profile** and select **Attach/Detach Hosts and Clusters** from the **Actions** drop-down menu.

6. In the Attach/Detach Hosts and Clusters dialog box, attach a host.

- a. In the left-side hosts list, select the ESXi host.
- b. Click the **Attach >** button to move the selected host to right-side list.
- c. Click **Next**.

A list of settings that can be customized for the host is provided. The customized values are prepopulated based on information extracted from the selected host.

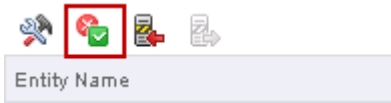
- d. Review the host customization settings and click **Finish**.

Task 5: Run an Initial Compliance Check

A compliance check verifies the attach host configuration against all the settings that are specified by the host profile. Host configurations that are contrary to the host profile are reported.

Student A and student B should do this task independently.

1. In the Host Profiles inventory tree, select **Imported-Profile**.
2. In the middle pane, click the **Monitor** tab and click the **Compliance** button.
3. In the hosts list, select the ESXi host and click the **Check Host Profile Compliance** icon.



4. In the Recent Tasks panel, monitor the compliance check to completion.
5. In the Compliance panel that appears below the host list, expand each report category and answer questions.

The compliance panel can be resized horizontally to increase the amount of information displayed. You can also point to messages to read the full text descriptions.

Q1. Is the ESXi host compliant with the Host Profile?

Q2. How many compliance categories are reported?

Q3. Of the compliance categories reported, how many are storage related?

Several issues are reported in the Core Storage Configuration category. The reason is the use of private logical unit numbers (LUNs) that cannot be shared between hosts. The issues can also be because of several other known issues related to device naming and ordering under native multipathing (NMP) or pluggable storage architecture (PSA).

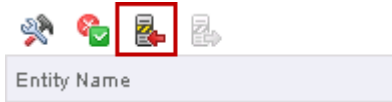
For examples of reasons for this behavior see VMware knowledge base article 2032822 at <http://kb.vmware.com/kb/2032822> and VMware knowledge base article 2002488 at <http://kb.vmware.com/kb/2002488>.

Task 6: Perform an Initial Remediation

Remediation generates a list of tasks to resolve each reported compliance issue. Not all issues can be remediated and, in this lab, you see that the Core Storage issues cannot be resolved due to the known problems described in the linked knowledge base articles.

Student A and student B should do this task independently.

1. To place the host in maintenance mode, click the **Enter Maintenance Mode** icon and click **OK** to confirm the action.



Hosts must be in maintenance mode for compliance remediation.

2. In the hosts list, select the ESXi host.
3. To begin host remediation, click the **Remediate host** icon.



- a. Review the customization settings and click **Next**.
Remediation begins with a review of the customized settings, in case the administrator has identified changes to be made.
 - b. Under Review Remediation Tasks, expand the ESXi host container and review the tasks that are created in response to the specific compliance issues found.
 - c. Click **Finish**.
4. In the Recent Tasks panel, monitor the remediation and subsequent compliance check tasks to completion.
 5. In the lower Compliance panel, verify that the iSCSI and Core Storage issues are not remediated.

Due to the nature of these issues, remediation is not possible in the context of this lab. See the previously referenced knowledge base articles for information about removing the relevant NMP and PSA items from the host profile.

Task 7: Introduce a Configuration Drift

You test host profile compliance verification and remediation by introducing a noncompliant change on the host.

Student A and student B should do this task independently.

1. Click the vSphere Web Client **Home** icon.
2. In the left pane, click **vCenter** and click **Networking**.
3. In the Networking inventory tree, select the **dvs-Infrastructure** distributed switch and select **Add and Manage Hosts** from the **Actions** drop-down menu.
4. In the Add and Manage Hosts dialog box, configure settings.
 - a. Select the **Manage host networking** radio button and click **Next**.
 - b. Under Select hosts, click the **Attached hosts** link, select the ESXi host check box, and click **OK**.
 - c. Click **Next**.
 - d. Under Select network adapter tasks, deselect the **Manage VMkernel adapters** check box and click **Next**.
 - e. Under Manage physical network adapters, select **vmnic1** and record the attached uplink.

 - f. Click **Unassign adapter** and click **Next**.
 - g. Under Analyze impact, click **Next**.
 - h. Click **Finish**.

Task 8: Run a Compliance Check and Remediate the Configuration Drift

You run a compliance check to detect noncompliant configuration changes that have been made to hosts attached to a host profile.

Student A and student B should do this task independently.

1. Click the vSphere Web Client **Home** icon.
2. On the Home tab, click the **Host Profiles** icon.
3. In the Host Profiles inventory tree, select **Imported-Profile**.
4. In the center pane Monitor > Compliance view, select the ESXi host and click the **Check Compliance** icon.
5. In the Recent Tasks panel, monitor the compliance check to completion.

6. In the Compliance panel, review the compliance categories and answer questions.
 - Q1. How do the results of the compliance check differ from the compliance check performed earlier in the lab?**

 - Q2. In the new category, does the specific issue reported relate to the configuration change made in the previous task?**
7. To begin host remediation, click the **Remediate host** icon.
 - a. Review the host customization settings and click **Next**.
 - b. Under Review Remediation Tasks, expand the ESXi host container and review tasks that are created in response to the specific compliance issues found.
 - c. Click **Finish**.
8. In the Recent Tasks panel, monitor the remediation and subsequent compliance check tasks to completion.
9. In the hosts list, select the ESXi host.
10. In the Compliance panel, verify that the Virtual Network Setting category no longer appears in the list.
11. Verify the action taken by host remediation.
 - a. Click the vSphere Web Client **Home** icon.
 - b. In the inventory tree, click **vCenter** and click **Networking**.
 - c. In the Networking inventory tree, select the **dvs-Infrastructure** distributed switch.
 - d. In the middle pane, click the **Manage** tab and click the **Settings** button.
 - e. Select the **Topology** link and verify that remediation automatically reconnected vmnic1 to the appropriate uplink.

Task 9: Introduce a Second Configuration Drift

Host profile compliance depends on the names of objects in a vCenter Server inventory, such as the name of an Uplink port group. A change is introduced that cannot be remediated because the name of the object is changed.

Student A and student B should do this task independently.

1. In the Networking inventory tree, select the **dvs-Inf-DVUplinks-12** port group.
2. Select **Rename** from the **Actions** drop-down menu.
3. In the Rename dialog box, type **dvs-Inf-DVUplinks-13**.
4. Click **OK**.

For the remediation to work, in the previous task, the uplinks port group on the dvs-Infrastructure distributed switch was preconfigured to be the same in the student A and student B vCenter Server inventories. Because of the object name dependencies, use of imported profiles can be problematic unless configuration items are excluded from the profile that would otherwise be a problem due to naming differences.

Task 10: Run a Compatibility Check and Try to Remediate the Host

You run a compliance check to detect the noncompliant configuration change and try to remediate the host.

Student A and student B should do this task independently.

1. Click the vSphere Web Client **Home** icon and click the **Host Profiles** icon.
2. In the Host Profiles inventory tree, select **Imported-Profile**.
3. In the center pane **Monitor > Compliance** view, select the ESXi host.
4. Click the **Check Compliance** icon.
5. In the Recent Tasks panel, monitor the compliance check to completion.
6. In the Compliance panel, review the reported categories to answer questions.

Q1. How do results of the compliance check differ from the compliance check performed earlier in the lab?

Q2. In the new category, does the specific issue reported relate to the configuration change made in the previous task?

7. To begin host remediation, click the **Remediate host** icon.
 - a. Review the host customization settings and click **Next**.
 - b. Under Review Remediation Tasks, expand the ESXi host container and review tasks that are created in response to the specific compliance issues found.
 - c. Click **Finish**.
8. In the Recent Tasks panel, monitor the remediation and subsequent compliance check tasks to completion.
9. In the hosts list, select the ESXi host.
10. In the Compliance panel, verify that the configuration category observed in the preceding steps was not remediated (category and issue are still reported).

Task 11: Detach the Host Profile and Exit Maintenance Mode

Clean up after using a host profile.

Student A and student B should do this task independently.

1. Click the **Exit Maintenance Mode** icon.



2. In the Recent Tasks panel, monitor the task to completion.
3. In the Host Profiles inventory tree, select the **Host Profiles** link.
4. In the middle pane, select **Imported-Profile** and select **Attach/Detach Hosts and Clusters** from the **Actions** drop-down menu.
5. In the Attach/Detach Hosts and Clusters dialog box, detach the host profile.
 - a. In the right-side list, select the ESXi host.
 - b. Click the **< Detach** button to move the host to the left-side list.
 - c. Click **Next**.
 - d. Click **Finish**.

Lab 17

Using VMware vSphere PowerCLI

Objective: Use vSphere PowerCLI to run basic Windows PowerShell cmdlets

In this lab, you will perform the following tasks:

1. Start vSphere PowerCLI
2. Define Variables
3. Connect to and Disconnect from an ESXi Host
4. Connect to the vCenter Server System and View ESXi Host-Related Information
5. List Virtual Networking Properties
6. Retrieve Virtual Machine Properties
7. Retrieve Virtual Machine Performance Statistics

Task 1: Start vSphere PowerCLI

You take a quick look at the basic VMware vSphere® PowerCLI™ commands.

Student A and student B should do this task independently.

1. Minimize all open windows.
2. On the Control Center desktop, double-click the **VMware vSphere PowerCLI** shortcut.
3. Wait for vSphere PowerCLI to initialize.
4. At the command prompt, type the `cd \` command.

vSphere PowerCLI commands are not case-sensitive, but file and folder paths are case-sensitive.

5. Display help.

```
Get-Help | more
```

Press the space bar to display the next help screen, or press Q to exit help.

6. Display help about a specific cmdlet, for example, the `Get-VMHost` cmdlet.

```
Get-Help Get-VMHost | more
```

You can use the Tab key to tab-complete a cmdlet. For example, type the first few letters of the command, such as `Conn` for `Connect-Viserver` cmdlet, and press the Tab key to tab-complete. You can use the tab-complete feature for variables also.

7. Get the vSphere PowerCLI version.

```
Get-PowerCLIVersion
```

8. View a list of all Windows PowerShell commands,.

```
Get-Command | more
```

9. View a list of vSphere PowerCLI commands.

```
Get-VICommand | Format-List | more
```

10. Retrieve the security policy for Windows PowerShell.

```
Get-ExecutionPolicy
```

11. View detailed information about the execution policy for the shell.

```
Get-Help Get-ExecutionPolicy | more
```

Task 2: Define Variables

Variables can be strings, such as a fully qualified domain name (FQDN), a set of security credentials, or an interactable object created in vSphere PowerCLI. Variables are not case-sensitive.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vCenter Server FQDN
 - ESXi FQDN
 - vSphere administrator user name
 - Standard lab password
1. Define a variable containing your VMware® ESXi™ host FQDN.

```
$vmHost = "esxi_fqdn"
```

Replace *esxi_fqdn* with your ESXi host's FQDN. Keep the quotation marks.

2. Define a variable containing your VMware® vCenter Server™ system FQDN.

```
$vCenter = "vcenter_fqdn"
```

Replace *vcenter-fqdn* with your vCenter Server system FQDN. Keep the quotation marks.

3. Define a variable containing the credentials necessary for logging in to the vCenter Server instance.

```
$vcCreds = Get-Credential
```

4. When prompted, type the VMware vSphere® administrator user name and the standard lab password.

Task 3: Connect to and Disconnect from an ESXi Host

You can connect to an ESXi host. However, VMware® recommends that you connect to the vCenter Server system to perform all tasks as if you are using the VMware vSphere® Client™.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
1. Connect to your ESXi host.

```
Connect-VIServer -Server $vmHost -User root -Password  
lab_password
```

Replace *lab_password* with the standard lab password.

2. Verify that the connection was established.

```
Get-VMHost
```

```
PowerCLI C:\> get-vmhost
WARNING: 3 columns do not fit into the display
Name                               ConnectionState PowerState
-----                               -
esxi01.vclass.local               Connected      PoweredOn
```

Your ESXi host and its connection and power state are listed.

3. Disconnect from the ESXi host.

```
Disconnect-VIServer -Server $vmHost
```

4. When prompted, type **Y** and press Enter.

Task 4: Connect to the vCenter Server System and View ESXi Host-Related Information

You use cmdlets to retrieve basic information, such as finding the number of CPUs, the amount of memory, and the ESXi version running on the host.

Student A and student B should do this task independently.

1. Connect to your vCenter Server system.

```
Connect-VIServer -Server $vCenter -Credential $vcCreds
```

2. Verify that your vCenter Server FQDN is listed in the output.

```
Name                               Port  User
-----                               -
vc02.vclass.local                 443  administrator@vsphere.local
```

3. Create a variable containing the ESXi host object.

```
$esxi1 = Get-VMHost $vmHost
```

- Interact with the host object variable to get the version of the ESXi host.

```
$esxi1.Version
```

The long-hand method of performing the same action is:

```
Get-VMHost -Name $vmHost | Select Name,  
    @{Name="Product";Expression={$_.ExtensionData.Config.Produ  
    ct.Name}}, Version
```

- Determine the number of CPUs on the ESXi host.

```
$esxi1.NumCPU
```

The long-hand method of performing the same action is:

```
Get-VMHost -Name $vmHost | Select numcpu | Format-List
```

- Find the total CPU capacity of the ESXi host.

```
$esxi1.CPUTotalMHz
```

The long-hand method of performing the same action is:

```
Get-VMHost -Name $vmHost | Select CpuTotalMhz | Format-List
```

- Determine the total memory capacity of the ESXi host.

```
$esxi1.MemoryTotalMB
```

The long-hand method of performing the same action is:

```
Get-VMHost -Name $vmHost | Select MemoryTotalMB | Format-List
```

- Determine the processor type of the ESXi host.

```
$esxi1.ProcessorType
```

The long-hand method of performing the same action is:

```
Get-VMHost -Name $vmHost | Select ProcessorType
```

- Determine a list of datastores that the ESXi host can access.

```
$esxi1 | get-datastore
```

A long-hand method of performing the same action is:

```
Get-VMHost -Name $vmHost | Get-Datastore
```

Task 5: List Virtual Networking Properties

You use cmdlets to list network adapters, port groups, and virtual switches.

Student A and student B should do this task independently.

1. List all of the virtual switches available on the ESXi host.

```
$esxi1 | Get-VirtualSwitch
```

2. In the output, read any warning messages that appear, specifically messages relating to the inclusion of distributed switch objects.

3. List all port groups defined on the ESXi host.

```
$esxi1 | Get-VirtualSwitch | Get-VirtualPortgroup
```

4. List all virtual machine adapters and networks to which the adapters are connected.

```
Get-VM | Get-NetworkAdapter
```

5. Show the switch port usage of all virtual switches on the ESXi host.

```
$esxi1 | Get-VirtualSwitch | Measure-Object -sum numports*
```

Task 6: Retrieve Virtual Machine Properties

Use cmdlets for retrieving and setting virtual machine properties.

Student A and student B should do this task independently.

1. Use the `Get-VM` and `Get-Member` cmdlets to determine the properties that can be returned about a virtual machine.

```
Get-VM | Get-Member
```

2. Retrieve a list of virtual machine names, the power state of the virtual machines, and the ESXi host where the virtual machines reside.

```
Get-VM | Select Name, Powerstate, VMHost
```

3. Retrieve all the virtual machine properties in one command. `fl` is the abbreviated version of `format-list`.

```
Get-VM | fl *
```

Task 7: Retrieve Virtual Machine Performance Statistics

You use the `Get-Stat` cmdlet to retrieve performance information about a virtual machine. You also write the output to an HTML file and a CSV file.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Your student designation

1. List the virtual machines on the ESXi host.

```
Get-VM
```

2. In the command output, find the Linux01 virtual machine.

Reminder for student B: Your Linux01 virtual machine is called Linux01 (2) with a space before the (2) prefix.

3. Create a variable to contain the Linux01 virtual machine object.

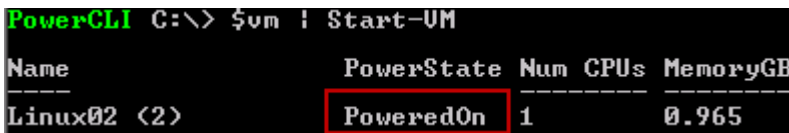
```
$vm = Get-VM "linux01_name"
```

Replace `linux01_name` with the name displayed in the `Get-VM` command output from step 2.

4. Start the virtual machine.

```
$vm | Start-VM
```

5. Wait 30 seconds for the power-on operation to complete and verify that the virtual machine power state is `PoweredOn`.



```
PowerCLI C:\> $vm | Start-VM
```

Name	PowerState	Num CPUs	MemoryGB
Linux02 <2>	PoweredOn	1	0.965

6. Monitor the virtual machine performance and collect one sample from each of the major subsystems.

```
$vm | Get-Stat -MaxSamples 1 -Realtime | Format-Table -autosize
```

7. Run the command without the format table option to output the results to an HTML file.

```
$vm | Get-Stat -MaxSamples 1 -Realtime | ConvertTo-Html |  
Out-File "C:\student_id.html"
```

Replace `student_id` with your student designation. For example, if you are student A, then you save the file as `StudentA.html`.

8. Restore the Firefox window, open a new tab, and go to the file://c:/student_id.html URL.
Replace *student_id* with your student designation. For example, if you are student B, then you type a URL of: file://c:/StudentB.html.
9. Review the HTML output, close the HTML TABLE browser tab, and minimize the Firefox window.
10. Monitor the virtual machine performance and output the results to a grid view.

```
$vm | Get-Stat -MaxSamples 1 -Realtime | Out-GridView
```
11. Review the grid view information and close the Out-GridView window.
12. Monitor the virtual machine performance and output the results to a CSV formatted file.

```
$vm | Get-Stat -MaxSamples 1 -Realtime | Export-CSV  
"C:\student_id.csv"
```


Replace *student_id* with your student designation. For example, if you are student A, then you save the file as c:\StudentA.csv.
13. Restore the Firefox window, open a new tab, and go to the file://c:/student_id.csv URL.
Replace *student_id* with your student designation. For example, if you are student B, then you type a URL of: file://c:/StudentB.html.
14. Review the CSV output and close the browser tab.
15. Keep the vSphere PowerCLI window open for the next lab.

Lab 18

Using VMware vSphere Auto Deploy on VMware vCenter Server Appliance

Objective: Configure vSphere Auto Deploy to boot hosts using stateless caching

In this lab, you will perform the following tasks:

1. Prepare for the Lab
2. Update a Host Profile to Enforce Stateless Caching
3. Create a Container for Autodeployed Hosts
4. Start the vSphere Auto Deploy Service
5. Open vSphere PowerCLI and Connect to the vCenter Server System
6. Create a Custom Image Profile
7. Create Deployment Rules
8. Configure DHCP
9. Start the TFTP Service on the vCenter Server Appliance
10. Review Autodeployment Preparation Steps
11. Prepare to Monitor ESXi Bootup During the Autodeploy Process
12. Reboot the ESXi Host and Monitor the Bootup Process
13. Use Host Profile Remediation to Customize the Autodeployed Host
14. Reboot the Host and Verify Stateless Caching

Task 1: Prepare for the Lab

You open the VMware vSphere® Web Client if it is not open.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vSphere administrator user name
 - Standard lab password
1. Open the vSphere Web Client if it is closed.
 - a. On the Control Center desktop, double-click the **Firefox** shortcut.
 - b. In the Firefox window, click the **vSphere Web Client** bookmark.
 - c. When prompted, log in as the VMware vSphere® administrator with the standard lab password.

All virtual machines should be in a powered-off state.

2. In the Hosts and Clusters inventory tree, select each running virtual machine (if any) and select **Shut Down Guest OS** from the **Actions** menu.

Task 2: Update a Host Profile to Enforce Stateless Caching

Using stateless caching, hosts can locally store a host image that is acquired from a Trivial File Transfer Protocol (TFTP) boot server. Using stateless caching ensures that hosts can boot using the previously cached image if any part of the network boot infrastructure becomes unavailable. Stateless caching is configured in a host profile. The host profile is delivered to a booting host as part of the autodeploy process, through the application of a deploy rule. Stateless caching overwrites any existing ESXi installation, making stateless reversion of the host to some previous state unavailable.

Student A and student B should do this task independently.

1. In the vSphere Web Client interface, click the **Home** icon.
2. On the Home page, click the **Host Profiles** icon.
3. In the Objects list, click the **Local-Profile** link to open and manage that object and click the **Manage** tab.

4. Click the **Edit Host Profile** button and enable stateless caching.
 - a. In the Edit Host Profile dialog box, click **Next**.
 - b. Under Edit Host Profile, in the settings tree, navigate to **Advanced Configuration Settings > System Image Cache Configuration > System Image Cache Configuration** and select the configuration item.
 - c. In the right pane, select **Enable stateless caching on the host** from the drop-down menu.

When hosts receive this profile, the host image is cached to a local drive or a thumb drive. The local cache is used whenever network boot is not available, or if network bootup is disabled on the host. A cached bootup takes less time to complete because the image does not need to be transferred over the network.
 - d. Leave the arguments for the first disk at the default value.

The option indicates that caching should use the disk that has VMware® ESXi™ installed.
5. In the settings tree, select the **Advanced Configuration Settings > System Image Cache Configuration** check box.
6. Click **Next**.
7. Under Ready to complete, click **Finish**.

Task 3: Create a Container for Autodeployed Hosts

Create a Hosts and Clusters folder in which autodeployed hosts appear. A deploy rule assigns hosts to the container.

Student A and student B should do this task independently.

1. In the vSphere Web Client interface, click the **Home** button.
2. In the left pane, click **vCenter** and click **Hosts and Clusters**.
3. In the Hosts and Clusters inventory tree, select the **Training** data center and select **All vCenter Actions > New Host and Cluster Folder** from the drop-down menu.
4. When prompted, type **Auto-Deployed-Hosts** in the folder name text box and click **OK**.

At this stage, you can create clusters, folders, or other vSphere configurations to apply to autodeployed hosts. Deploy rules enable selective application of host profiles and destination containers to hosts that are booting up.

Task 4: Start the vSphere Auto Deploy Service

On a Windows-based VMware® vCenter Server™ system, the VMware vSphere® Auto Deploy™ component must be installed. On VMware® vCenter™ Server Appliance™, the vSphere Auto Deploy capability is already installed, but the service is not started by default.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
1. In the Firefox window, open a new tab and click the **vCenter Administration** bookmark.
 2. When prompted, log in as root with the standard lab password.
 3. On the Summary tab, scroll down to uncover the **Services** panel and click the vSphere Auto Deploy **Start** button.
 4. Verify that the service status is Running, log out of the administration console, and close the browser tab.

Task 5: Open vSphere PowerCLI and Connect to the vCenter Server System

A VMware vSphere® PowerCLI™ window might already be open from the previous lab. If the window is open, you must set the execution policy.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vCenter Server FQDN
 - vSphere administrator user name
 - Standard lab password
1. If the vSphere PowerCLI window is closed, start vSphere PowerCLI and connect to the vCenter Server system.
 - a. Minimize the Firefox window.
 - b. On the Control Center desktop, double-click the **VMware vSphere PowerCLI** shortcut.
 - c. In the vSphere PowerCLI window, wait for the command prompt to appear.

- d. Connect to the vCenter Server system.

```
Connect-VIServer -Server "vcenter_fqdn" -User  
vsphere_administrator -Password lab_password
```

Replace *vcenter_fqdn* with the fully qualified domain name (FQDN) of your vCenter Server system.

Replace *vsphere_administrator* with the vSphere administrator user name.

Replace *lab_password* with the standard lab password.

- e. Verify that the vCenter Server instance is listed with a port of 443.

Name	Port
vc02.vclass.local	443

2. Determine the current vSphere PowerCLI execution policy.

```
Get-ExecutionPolicy
```

3. Set the execution policy to unrestricted.

```
Set-ExecutionPolicy unrestricted
```

4. When prompted, type **Y** and press Enter to confirm the execution policy change.

Task 6: Create a Custom Image Profile

You add an offline depot, clone an image profile, and export the profile to an ISO image and a zip bundle.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- vCenter Server FQDN (host name portion)

1. Select the vSphere PowerCLI window.
2. Add an offline software depot to Image Builder.

```
Add-ESXSoftwareDepot c:\depot\LabDepot.zip
```

The depot URL is displayed.

```
PowerCLI C:\> add-esxsoftwaredepot  
  
Depot Url  
-----  
zip:C:\depot\labdepot.zip?index.xml
```

3. Verify that the existing image profiles can be read.

```
Get-ESXImageProfile
```

Two different profiles are displayed.

```
PowerCLI C:\> get-esximageprofile
```

<u>Name</u>	<u>Vendor</u>
ESXi-5.5.0-1331820-standard	VMware, Inc.
ESXi-5.5.0-1331820-no-tools	VMware, Inc.

4. Create an image profile by cloning the 5.5.0 no-tools profile.

```
New-ESXImageProfile -CloneProfile ESXi-5.5.0-1331820-no-tools  
-Name vcenter_id -Vendor "VMware, Inc."
```

Replace *vcenter_id* with your vCenter Server host name. For example, if you are student A, then your vCenter Server host name is VC01.

The command is case-sensitive and must include the specific vendor (VMware, Inc.).

When this step is complete, you can continue to customize the image profile. You can use the `Add-ESXSoftwarePackage` command to add VMware® or third-party installation bundles (VIBs) to the image profile. For this lab, no further customization is performed.

5. Export the cloned profile as an ISO image and a ZIP bundle.

```
Export-ESXImageProfile -ImageProfile vcenter_id -ExportToISO  
-FilePath c:\depot\vcenter_id.iso
```

```
Export-ESXImageProfile -ImageProfile vcenter_id -ExportToBundle  
-FilePath c:\depot\vcenter_id.zip
```

Replace both instances of *vcenter_id* in each command with your vCenter Server system host name, using the same character case.

For example, for student B:

```
Export-ESXImageProfile -ImageProfile VC02 -ExportToISO -FilePath  
c:\depot\VC02.iso
```

6. When the image profile is exported, verify that the ISO and ZIP files have been created.

```
ls \depot
```

```
                LastWriteTime          Length Name  
-----  
12/16/2013   7:03 PM   337919930 LabDepot.zip  
12/19/2013   9:53 AM   173817856 UC02.iso  
12/19/2013  11:07 AM   163625009 UC02.zip
```

Task 7: Create Deployment Rules

Deployment rules associate host profiles, image profiles, destination containers, and many other capabilities to hosts engaged in the autodeploy process. Different sets of rules can associate different characteristics to hosts based on several conditions and qualifiers, such as the network on which the host boots.

Student A and student B should do this task independently.

1. Create a deployment rule, named ImageRule, that associates the custom image profile created in the preceding task with all booting hosts.

```
New-DeployRule -Name ImageRule -Item vcenter_id -allhosts
```

Replace *vcenter_id* with your vCenter Server instance host name, using the same character case. For this command, `-Item` references the name of the image profile to be applied to autodeployed hosts. The `-Item` parameter is contextual, based on the command.

Because the specified profile is not previously registered with the vSphere Auto Deploy server, the packages must be first uploaded. The upload occurs when a new rule is created that references the image.

2. Monitor the upload process to completion.

The process might take a few minutes to complete.

3. Create a deployment rule called ProfileRule that associates the host profile enabling stateless caching to all booting hosts.

```
New-DeployRule -Name ProfileRule -Item Local-Profile -allhosts
```

The specified image and host profile are associated to autodeployed hosts based on broad default criteria. The criteria specifically include the vendor associated with the profile (VMware, Inc.) with no other constraints to control host selection.

4. Add an additional pattern to the image rule to tighten the specification by which hosts receive the particular image.

```
Set-DeployRule ImageRule -Pattern "ipv4=172.20.10.200-  
172.20.10.254"
```

The additional IPv4 parameter is the management network Dynamic Host Configuration Protocol (DHCP) range on which hosts boot. Only those hosts that receive an IP in this range are assigned the image. You can add patterns to any deploy rule to create such specifications.

5. Create a deployment rule called ContainerRule that assigns autodeployed hosts to a particular container.

```
New-DeployRule -Name ContainerRule -Item Auto-Deployed-Hosts -  
allhosts
```

6. Verify that the new rules appear in the working rule set.

```
Get-DeployRule
```

7. Add the new rules to the active rule set.

```
Add-DeployRule -DeployRule ImageRule
```

```
Add-DeployRule -DeployRule ProfileRule
```

```
Add-DeployRule -DeployRule ContainerRule
```

8. Verify that the rules appear in the active rule set.

```
Get-DeployRuleSet
```

Task 8: Configure DHCP

Each student configures a single DHCP reservation in the Management network scope to focus vSphere Auto Deploy on a single ESXi host based on the host media access control (MAC) address. Individual reservations are used, instead of configuring options for a full scope. The lab team can simultaneously autodeploy hosts using the same DHCP scope with different options set for each reservation.

Student A and student B should do this task independently, after exchanging the Management network MAC address of the ESXi hosts.

Use the following information from the class configuration handout:

- Student designation
 - vCenter Server IP address
 - vSphere Auto Deploy DHCP scope name
 - vSphere Auto Deploy reservation IP
1. Minimize the vSphere PowerCLI window.
 2. Restore the Firefox window.
 3. Determine the Management network MAC address of your ESXi host.
 - a. In the Hosts and Clusters inventory tree, select the ESXi host.
 - b. In the middle pane, click the **Manage** tab and click the **Networking** button.
 - c. Select the **Physical adapters** link.
 - d. Scroll to the right if needed to uncover the MAC address column and record your host vmnic0 MAC address. _____

4. Exchange MAC addresses with your lab partner and record the reservation MAC address that you use in your DHCP reservation. _____
5. Continue only after you and your lab partner have exchanged MAC addresses.
6. Minimize the Firefox window.
7. On the Control Center desktop, double-click the **DHCP** shortcut.
8. In the DHCP console window, expand the left pane so that the existing scopes are fully visible. Resize the left and right panes by dragging the pane separator to the right.
9. Expand the vSphere Auto Deploy DHCP scope specified in the class configuration handout, and select **Reservations**.
10. Configure a new reservation using the MAC address of your lab partner's ESXi host.
 - a. Right-click **Reservations** and select **New Reservation**.
 - b. In the New Reservation dialog box, configure the settings.

Option	Action
Reservation name	Type <i>student_id_reservation</i> in the text box. Replace <i>student_id</i> with your student designation, for example, for student B, the reservation name is: StudentB_reservation.
IP address	Type the vSphere Auto Deploy reservation IP specified in the class configuration handout.
MAC address	Type the MAC address that you obtained from your lab partner, using - (hyphen) as a delimiter. Example: 00-50-56-01-49-86
Description	Leave blank.
Supported types	Leave the Both radio button selected.

- c. Click **Add** and click **Close**.

The new reservation appears in the DHCP console window, in the right pane.

11. In the left pane, expand **Reservations** so that your new reservation appears.
The reservation names are in the form: [nnn.nnn.nnn.nnn] StudentB_reservation, or [nnn.nnn.nnn.nnn] StudentA_reservation.
[nnn.nnn.nnn.nnn] should be the reservation IP that you typed.
12. Select your reservation and verify that options inherited from the parent scope appear in the right pane.
The scope-inherited options should include:
 - 003 Router
 - 006 DNS Servers
 - 015 DNS Domain Name
13. In the left pane, right-click your reservation and select **Configure Options**.
14. In the Reserved Options dialog box, on the **General** tab, scroll down to the **066 Boot Server Host Name** option.
15. Select the **066 Boot Server Host Name** option check box and type your vCenter Server IP address in the **String value** text box.
16. In the options list, select the **067 Bootfile Name** check box and type `undionly.kpxe.vmw-hardwired` in the **String value** text box.
17. Click **OK**.
18. Verify that your new options appear in the right pane.
The inherited options and reservation-specific options have different icons to identify them.
19. Minimize the DHCP console window.

Task 9: Start the TFTP Service on the vCenter Server Appliance

The appliance is already configured to serve as a TFTP server for vSphere Auto Deploy. The service must be started.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Standard lab password
1. On the Control Center desktop, double-click the **PuTTY** shortcut.
 2. In the PuTTY window, double-click the **vCenter Appliance** session.
 3. Log in as root with the standard lab password.

4. View the TFTP service configuration to answer the question.

```
more /etc/sysconfig/atftpd
```

Q1. At the bottom of the first page, what is the TFTP directory set to?

5. View the contents of the TFTP directory to answer the question.

```
ls /srv/tftpboot
```

Q2. In the /srv/tftpboot file list, do you see the TFTP boot image filename that you typed when configuring DHCP options for your reservation?

6. Start the TFTP service.

```
service atftpd start
```

7. Verify that the TFTP service has started.

```
service atftpd status
```

The TFTP service does not start automatically when the vSphere Auto Deploy service is started from the vCenter Server administration console.

Task 10: Review Autodeployment Preparation Steps

You review your work and prepare for autodeployment.

Student A and student B should do this task independently.

1. Review the configuration and autodeployment steps.

- Containers and host profiles for use by autodeployed hosts are configured.

The use of containers can be beneficial when designing prestaging and poststaging scenarios for host deployments.

- Stateless caching is enabled on autodeployed hosts.

If the supporting TFTP/DHCP/BOOTP infrastructure becomes unavailable, stateless caching ensures that hosts continue to operate based on the last image cached, even if rebooted.

- The vSphere Auto Deploy service is started from the vCenter Server administration console.

- A custom host image profile is created.

Custom image profiles enable you to customize deployments for different sets of hosts and can be updated and customized with additional VMware or third-party software packages.

- Deployment rules are created to associate an image profile, host profile, and a container to specific auto-deployed hosts.

Using rules with different patterns allows different image, host profile, and other configurations to be assigned to groups of hosts.

- DHCP options are configured to identify a TFTP server and a boot image file name.
- The TFTP service is started on the vCenter Server Appliance.

For expediency, the lab environment uses the vCenter Server Appliance as the TFTP server. In production, a compatible TFTP service can be used that is not collocated with the vCenter Server Appliance.

Task 11: Prepare to Monitor ESXi Bootup During the Auto-deploy Process

For classes hosted on the VMware vClass2 platform, the ESXi hosts are preconfigured to boot from the network. You move out of your sandbox and use the vClass2 Web interface to open a console to the ESXi host. You autoboot to observe the bootup sequence.

Student A and student B should do this task independently.

1. Ensure that you have your student login credentials.
 - If your class is not hosted in the VMware vClass2 environment, ask your instructor for information about accessing the console of the ESXi host for monitoring the bootup sequence.
 - If you are attending a class hosted on the VMware vClass2 platform you must have your student login credentials at hand. Your login credentials are sent to you in a class welcome email. Your instructor can help you if you have lost your login information.

2. Record the VMware vClass2 URL provided by your instructor. _____

The URL should be similar to: `wdc-vclass-a.vmeduc.com/cloud/org/classroom-101`

3. Minimize the Remote Desktop Protocol (RDP) session to the Control Center in your lab sandbox.

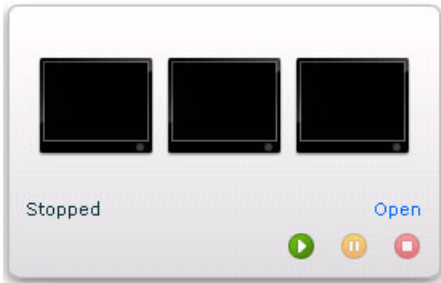
You can access the desktop of the server that you first logged in to at the start of the class.

4. On the login server desktop, double-click the **Internet Explorer** shortcut.
5. In the Internet Explorer window, browse to the vClass2 URL that you recorded earlier.

- When prompted, log in using the student credentials.

The user name and password are the same as used to access the login server at the start of the class.

- In the vClass2 VMware® vCloud Director® interface, on the **Home** tab, one vApp is displayed.



- In the vApp box, click the **Open** link that appears above the **Stop** icon.

The vClass2 vCloud Director interface changes to the **My Cloud** tab, with the vApp details shown in the right pane.

- In the right pane, click the **Virtual Machines** tab.
- In the virtual machines list, find your lab partners' ESXi host.
 - If you are student A, then find the ESXi02 virtual machine.
 - If you are student B, then find the ESXi01 virtual machine.



- Display the console view of the ESXi host that you autodeploy
 - Click the monitor icon or select the host virtual machine.

The monitor icon is the icon that fills the left-most column and looks like a computer monitor.

- b. Select **Popout Console** from the Gear icon menu that appears above the list.

A new Internet Explorer window opens, showing the console view of the selected ESXi host.

If the Internet Explorer popup blocker blocks the console from opening, select the Always allow popups option and perform the operation again.

Task 12: Reboot the ESXi Host and Monitor the Bootup Process

While monitoring the ESXi host console, you reboot the host and observe the autoboot experience.

Student A and student B should do this task independently, after coordinating host reboot.

Use the following information from the class configuration handout:

- Standard lab password
1. Click inside the ESXi console window and press any key.
The ESXi console view becomes active after a key is pressed.
 2. Press the F12 key, and log in as root with the standard lab password.
 3. Restart the ESXi host by pressing the F11 key.
 4. Press Enter to confirm the reboot.
 5. Monitor the ESXi host bootup process.
 - The host performs a network preboot execution environment (PXE) boot
The host contacts the TFTP server identified in the DHCP scope options.
 - The image binaries are transferred to the host and installed.
This process can take up to 20 minutes to complete
 - ESXi modules are loaded and associated host profile tasks are performed.
 - Services are started
 6. When the reboot is complete, and the ESXi console interface becomes dimmed, press Ctrl+Alt to release the pointer and minimize the console window.
 7. Restore the minimized RDP session to the Control Center in your lab sandbox.

Task 13: Use Host Profile Remediation to Customize the Autodeployed Host

Full remediation of an autodeployed host is not performed. Each autodeployed host must be minimally configured so that the host can handle workloads as a member of a cluster. You perform the minimal configuration of the host networking.

Student A and student B should do this task independently.

Use the following information from the class configuration handout:

- Production network address

1. Restore the minimized Firefox window.

2. In the Hosts and Clusters inventory tree, expand the **Auto-Deployed-Hosts** folder.

The autodeployed host appears in the folder, with the reservation IP as the host name. The host is in maintenance mode, which is the expected condition after autodeploy.

3. Click the **Home** icon.

4. On the Home page, click the **Host Profiles** icon.

5. In the Host Profiles inventory tree, click the **Local-Profile** item.

6. In the middle pane, click the **Monitor** tab and click the **Compliance** button.

7. In the host list, select the autodeployed ESXi host.

8. Click the **Check Host Profile Compliance** icon and wait for the compliance check to complete.

The host is not in compliance.

9. Click the **Remediate host** icon.

10. In the Remediate host dialog box, resize the dialog box and the columns so that the Path column is displayed.

11. Under Customize hosts, click the Path column heading to sort the list by path.

12. Configure the host settings.

- Based on your student A or B designation, replace ### in an IP address in the table.
 - Student A: Use 151 as the fourth octet, for example, 172.20.10.151.
 - Student B: Use 152 as the fourth octet, for example, 172.20.10.152.

- For each setting to be configured, the property name (type of value) and a key phrase from the path are provided in the table. Match the property name and the key phrase to the correct item in the settings list and configure that setting with the specified value.

Property Name	Key Phrase in Path	Value
Host IPv4 address	Networking ... Management Network	172.20.10.###
Subnet mask	Management Network	255.255.255.0
MAC Address	pg-IPStorage	Leave blank.
Host IPv4 address	pg-IPStorage	172.20.13.###
Subnet mask	pg-IPStorage	255.255.255.0
MAC Address	pg-vMotion	Leave blank.
Subnet mask	pg-vMotion	255.255.255.0
Host IPv4 address	pg-vMotion	172.20.12.###
MAC Address	pg-Production	Leave blank.
Subnet mask	pg-Production	255.255.255.0
Host IPv4 address	pg-Production	172.20.11.###
iSCSI Alias for ...	iSCSI Initiator Configuration	Leave blank.
Specify IQN for ...	iSCSI Initiator Configuration	Leave default.
Disable the adapter...	iSCSI Initiator Configuration	Leave deselected.

13. Click **Next**.
14. Under Review Remediation Tasks, expand the report and review tasks to be performed.
15. When ready, click **Finish**.
16. In the Recent Tasks panel, monitor the remediation and related tasks to completion.
17. Click the **Exit Maintenance** mode icon to remove your host from maintenance mode.

Task 14: Reboot the Host and Verify Stateless Caching

You delete the DHCP reservation so that the host chooses to perform a cached boot after failing to receive boot options.

Student A and student B should do this task independently, after coordinating host reboot.

1. Delete your DHCP reservation so that the host cannot boot from the network.
 - a. Restore the minimized DHCP console window.
 - b. In the left pane, right-click the reservation that you created earlier and select **Delete**.
 - c. When prompted, click **Yes** to confirm the deletion.
 - d. Close the DHCP console window.
2. Reboot the ESXi host.
 - a. In the vSphere Web Client, click the **Home** icon.
 - b. In the left pane, click **vCenter** and click **Hosts and Clusters**.
 - c. In the Hosts and Clusters inventory tree, select the ESXi host and select **Reboot** from the **Actions** drop-down menu.
 - d. When prompted, click **OK** to confirm the reboot.
3. Minimize the RDP window to the Control Center in your lab sandbox.
4. On the login server, restore the minimized ESXi console window.
5. Wait for the host reboot to start.

The process might take a couple of minutes. The console remains static until the host finishes the shutdown procedure and begins to bootup.

6. Monitor ESXi bootup sequence.
 - After the network boot fails, the ESXi host begins a normal startup operation.

The host image is neither transferred to nor installed on the host. Although not reported as such, the host is booting from the cached image because stateless caching is configured.

If stateless caching is never configured and an autodeployed host is rebooted in an environment where autodeploy is not available (for example, TFTP server is down), the host boots the original installation of ESXi and attaches to the original vCenter Server system.
 - Host profile tasks are executed in response to modules being loaded.

This response indicates that the host is applying the host profile specified in the vSphere Auto Deploy rules.

- A final set of host profile tasks is generated and then applied.

The host customization settings and remediation tasks that have been identified are applied at the end of the startup sequence.

- After the host bootup completes, the console interface reports the customized IP address configured for the host in the tools URL.

In the preceding task, you configured the management network IP address for the host as 172.20.10.151 or 172.20.10.152 depending on your student A/B designation. The DHCP reservation for the host was an IP address in the range of 172.20.10.250 through 172.20.10.254.

7. Close the ESXi host console window.

8. Restore the minimized RDP window to the Control Center in your lab sandbox.

Answer Key

Lab 2: VMware Monitoring Tools

- Task 8: Use Windows Performance Monitor to Display Captured Statistics20
1. No
 2. The graph is not updated because the data is not sampled in real time. The data has been read from a static CSV file.

Lab 5: Monitoring Network Performance

- Task 8: Stop the Test and Analyze Results49
1. Yes.
 2. The same port group test.
 3. Because the network traffic was contained within the port group, handled completely by the ESXi host, in software. Not only are general network operations faster in a purely software-defined scenario, but network mechanics are handled more efficiently, such as frame collision.

Lab 10: Command-Line Storage Management

- Task 9: Generate the Second Seek Distance Histogram and Compare the Data90
1. The second script generates sequential write operations.
 2. The second script generates writes resulting in mostly uniform seek distances.

Lab 12: Diagnosing CPU Performance Issues

- Task 2: Check for CPU Saturation on an ESXi host107
1. Yes. The average CPU usage is greater than 75 percent, likely in the 99+ percent range.
 2. Yes. The maximum is 100 percent.
 3. Yes.
- Task 3: Check for CPU Saturation or Low CPU Utilization on a Virtual Machine108
1. No, the utilization is likely somewhere between 40 and 60 percent.
 2. Yes, the chart value is about half of what resxtop reports.
 3. Likely not unless first-hand experienced. Reason is that resxtop is aggregating the %USED for each CPU where the chart is averaging.

- 4. No, it is impossible to say with the current values other than that none of the values are > 75 percent. So CPU saturation does not exist.
- 5. Yes, there might be momentary differences of 10 percent or more, but in general the numbers quickly align to around a 2 percent difference. The answer might be No if the values are recorded at an odd moment, but in general these values circle around the same center.
- 6. Yes.
- 7. resxtop was aggregating vCPU values, while the chart was averaging.
- 8. No, because the reported value is an aggregate and does not represent a percentage of actual compute power consumed.
- 9. Yes, the value should be 10,000+ ready on both vCPUs.
- 10. Yes, likely 50 percent or higher for each vCPU.

Task 4: Check SMP Status on a Virtual Machine111

- 1. No, both are operating as SMP.

Task 5: Summarize the Results112

- 1. Yes, very likely.
- 2. Yes.

Lab 13: Monitoring Memory Performance

Task 3: Check for Overcommitment of Virtual Machine Memory117

- 1. Yes. The consumed host memory is around 1GB, and the active host memory is around 642MB because Linux01 is the only virtual machine running.

Task 6: Observe Baseline Memory Statistics119

- 1. The virtual machine is not performing any tasks that require large amounts of memory and the host has sufficient resource to give to the virtual machine to meet current load requirements.

Task 9: Record Memory Statistics122

- 1. Yes. Ballooning is indicated in Latest value.
- 2. Not presently. Swapping occurred at some point as indicated by a peak (maximum) value
- 3. Yes.

Lab 14: Diagnosing Memory Performance Issues

Task 4: Check for Active Host-Level Memory Swapping128

- 1. Yes.

Task 5: Determine Which Virtual Machines Are Affected by Host-Level Memory Swapping129

- 1. Yes.
- 2. The answer depends on the timing of when this question is answered, other machines might be actively swapped instead.

Task 6: Check for Past Host-Level Swapping131

- 1. Yes.

Task 7: Determine Which Virtual Machines Are Affected by Past Host-Level Swapping .	132
1. Yes.	2. Yes.
Task 8: Check for Guest Operating System Paging at the Host Level	133
1. Yes.	
Task 9: Check for Guest Operating System Paging in Each Virtual Machine.	134
1. Yes.	3. The answer depends on the current state of the host swap operations.
2. Yes.	
Task 10: Check for High Guest Memory Demand.	135
1. Yes.	2. Yes.

Lab 15: Diagnosing VMware vSphere HA Cluster Resource Issues

Task 7: Investigate the First Cluster Issue	144
1. Based on the 50 percent failover threshold, sufficient cluster resources were available to start both virtual machines.	4. Both virtual machines failed to start.
2. At some point, as virtual machines are started, cluster resources fall below the failover threshold and attempts to start additional machines fail. The occurrence of such a failure is entirely dependent on the resource needs of each virtual machine that is started.	5. Insufficient resources to satisfy configured failover level for vSphere.
3. Sufficient CPU resources exist (barely) to start another copy. However, memory is all but depleted to the threshold value.	6. No. Sufficient CPU resources were available. Only memory might have depleted.
	7. Memory.
	8. Two possible solutions are the following: Increase the amount of physical resources available to the cluster or decrease the resource reservations of one or more of the virtual machines in the cluster.
Task 9: Investigate the Second Cluster Issue and Start Your First Virtual Machine	147
1. Host failover, fixed slot size.	2. Yes. Sufficient resources are available.
Task 12: Determine the Cause of the Second Cluster Issue	150
1. Powering on the virtual machine reduced failover resources below the level required for full vSphere HA coverage, but left enough resources for the cluster to perform best effort failover as needed.	5. The slot size has been explicitly defined and should be 1024MHz, 1 virtual CPU, and 2048MB.
2. Powering on the virtual machine might have completely depleted cluster failover resources.	6. Yes. The slot size is large enough. Each of the virtual machines for Cluster-2 is configured with 1 vCPU and 384MB of memory.
3. No. The current failover capacity should be 0 hosts (if you have 2 hosts in the cluster). Even with a current failover capacity of 0 hosts, insufficient failover capacity is caused if one of the hosts is down. In this lab, the assumption is that both hosts are up and running.	7. The number of slots available dropped below half, meaning that in a worst-case scenario not all virtual machines might fail over. After the third virtual machine was started, a single slot remained for limited failover use.
4. No. The virtual machines that are used for the Cluster-2 problem do not have CPU or memory reservations set.	8. vSphere maintains a minimum of one slot for failover use on the cluster. Sufficient slots were not available.

9. If the slot is too large, then decrease the size of the slot. The slot size might have been explicitly set. Check the Admission Control Policy options in the vSphere HA cluster settings. Another possible solution is to add more physical CPU and memory resources to the cluster.

Lab 16: Host Profiles

Task 5: Run an Initial Compliance Check159

1. No. The host is not compliant.
2. Four.
3. Two: iSCSI and Core Storage Configuration.

Task 8: Run a Compliance Check and Remediate the Configuration Drift161

1. The Virtual Network Setting category appears. If the category was previously reported, a new issue is added relating to the uplink reconfiguration.
2. Yes. Uplink is not connected to the expected physical NIC on dvs-Infrastructure.

Task 10: Run a Compatibility Check and Try to Remediate the Host163

1. The Virtual Network Setting category appears. If the category was previously reported, a new issue is added relating to the uplink reconfiguration.
2. Yes. Uplink portgroup dvs-DVUplinks-12 not found.

Lab 18: Using VMware vSphere Auto Deploy on VMware vCenter Server Appliance

Task 9: Start the TFTP Service on the vCenter Server Appliance182

1. AFTPD_DIRECTORY = "/srv/tftpboot"
2. Yes, undionly.kpxe.vmw-hardwired.