VMware vSphere: Optimize and Scale

Student Lab Manual
ESXi 5.1 and vCenter Server 5.1

VMware® Education Services
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VMware vSphere:
Optimize and Scale
ESXi 5.1 and vCenter Server 5.1
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TABLE OF CONTENTS

Lab 1

Using VMware vSphere Management Assistant

Objective: Use vMA to manage ESXi hosts and virtual machines

In this lab, you will perform the following tasks:

1. Access your student desktop system.
2. Verify that your vSphere licenses are valid.
3. Power on a virtual machine.
4. Enable the ESXi Shell and SSH services.
5. Log in to vMA and connect to your vCenter Server and ESXi host.
6. Use esxcli commands to retrieve information about an ESXi host.
7. Use vicfg commands to configure NTP.
8. Use vmware-cmd to manage virtual machines.

Preparing for the lab

Record the following information:

Desktop Administrator password _____

VMware® vCenter Server™ system name _____

vCenter Server Administrator password _____

vCenter Server license key _____

VMware vSphere® Enterprise Plus Edition™ license key _____

Test virtual machine name _____

VMware vSphere® Management Assistant (vMA) system name _____

vMA user name _____

vMA vi-admin password _____

VMware vSphere® ESXi™ host name _____

ESXi host root password _____

NTP server _____

Path to the Windows virtual machine .vmx file _____

Task 1: Access your student desktop system

In this task, you will log in to your student desktop system as user Administrator. Students should do the steps in this task individually.

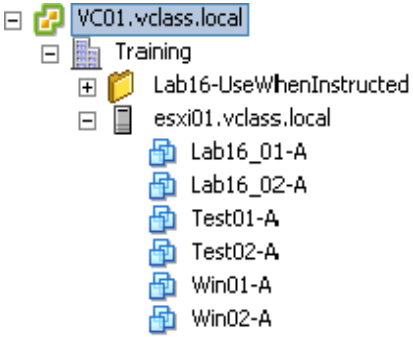
1. Ask your instructor how to access your student desktop system. For example, your instructor might have you use Remote Desktop Connection to connect to your student desktop system. Additionally, depending on your lab environment, your student desktop system and the vCenter Server system might be the same system.
2. Log in to your student desktop system as user Administrator, with the password that you recorded in "Preparing for the lab."

Task 2: Verify that your vSphere licenses are valid

In this task, you will log in to your vCenter Server system and determine whether your VMware vSphere® licenses are valid. If your licenses have expired, then you will add valid, temporary licenses to your vCenter Server. Students should do the steps in this task individually.

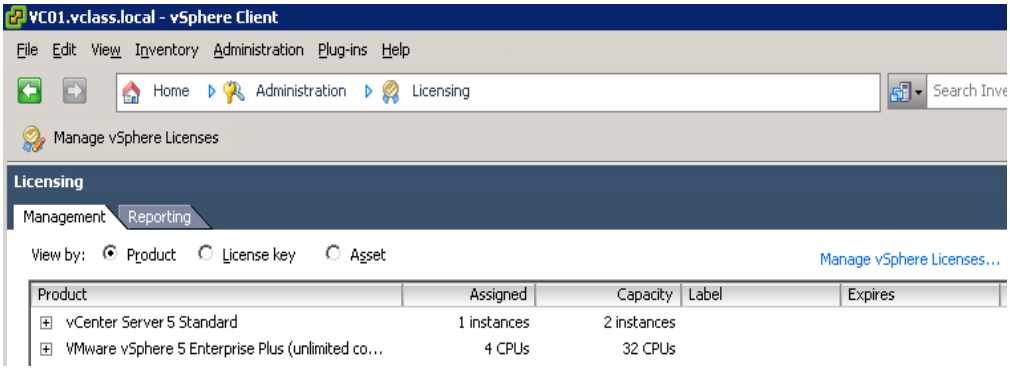
1. Start the VMware vSphere® Client™ and use it to log in to your vCenter Server system as user Administrator. You recorded your vCenter Server system name and vCenter Server Administrator password in "Preparing for the lab."

   Your vCenter Server inventory has been populated with several objects. Your inventory should look similar to the following inventory:



   If your ESXi host is marked as "(disconnected)" in the inventory, then your license has probably expired.

2. Select **Home** > **Administration** > **Licensing**. The **Licensing** pane is displayed.



3. In the **Management** tab, expand the products in the list and determine whether the vCenter Server license and the vSphere 5.1 license have expired.

4. If the licenses are expired, then add licenses to vCenter Server (if the licenses are not expired, then proceed to task 3):

   a. Click the **Manage vSphere Licenses** link in the upper-right corner.

   b. When prompted by the Manage vSphere Licenses wizard, perform the following actions.

Wizard Page	Action
Add License Keys	In the **Enter new vSphere license keys (one per line)** field, enter the vCenter Server license key and the vSphere Enterprise Plus license key. You recorded these license keys in "Preparing for the lab." **TIP** Include the hyphens: XXXXX-XXXXX-XXXXX-XXXXX-XXXXX. (The text box forces you to enter a hyphen every five characters.) In the **Enter optional label for new license keys** field, type **`VMware Training Licenses`** and click **Add License Keys**. Click **Next**.
Assign Licenses	Click the **Show all** radio button. If a security warning appears, click **Ignore**. In the **ESX** tab, your ESXi host appears in the left pane. In the right pane, select the valid license. Click the **vCenter Server** tab. In the **vCenter Server** tab, your vCenter Server system appears in the left pane. In the right pane, select the valid license. Click **Next**.
Remove License Keys	Do not select anything and click **Next**.
Confirm Changes	Click **Finish**.

   c. In the **Management** tab, expand the products and verify that the licenses have been successfully added.

d. Select **Home** > **Inventory** > **Hosts and Clusters**.

e. If your ESXi host is the status “disconnected,” then right-click your ESXi host and select **Connect**. Click **Yes** to confirm reconnecting the host. Verify that your ESXi host is reconnected.

Task 3: Power on a virtual machine

In this task, you will power on one of your virtual machines. Students should do the steps in this task individually.

1. Select **Home** > **Inventory** > **Hosts and Clusters**.
2. In the inventory, find the test virtual machine whose name you recorded in “Preparing for the lab.”
3. Power on the virtual machine. Right-click the virtual machine and select **Power** > **Power On**.

   Allow the virtual machine to boot up. You use it later in the lab.

Task 4: Enable the ESXi Shell and SSH services

In this task, you will start the VMware vSphere® ESXi™ Shell and SSH services on your ESXi hosts. Students should do the steps in this task individually.

1. Select your ESXi host in the inventory whose name you recorded in “Preparing for the lab.”
2. Click the **Configuration** tab.
3. In the **Software** panel, click the **Security Profile** link.
4. Click the **Properties** link to the right of the Services heading. The Services Properties dialog box is displayed.
5. Select **ESXi Shell** and click **Options**. The ESXi Shell (TSM) Options dialog box is displayed.
6. For the startup policy, select **Start and stop with host**.
7. Click **Start**. The ESXi Shell service is started. Click **OK**.
8. Verify that the ESXi Shell service has a status of Running.
9. Select **SSH** and click **Options**.
10. For the startup policy, select **Start and stop with host**.
11. Click **Start**. The SSH service is started. Click **OK**.
12. Verify that the SSH service has a status of Running.
13. Click **OK** to close the Services Properties dialog box.

Task 5: Log in to vMA and connect to your vCenter Server and ESXi host

In this task, you will log in to vMA, connect your vCenter Server system and your ESXi host to vMA, and verify your configuration. Students should do the steps in this task individually.

NOTE

All commands must be typed in a single line unless otherwise indicated. (Due to the formatting of the lab book, commands might appear on two lines instead of one.) All commands are case-sensitive.

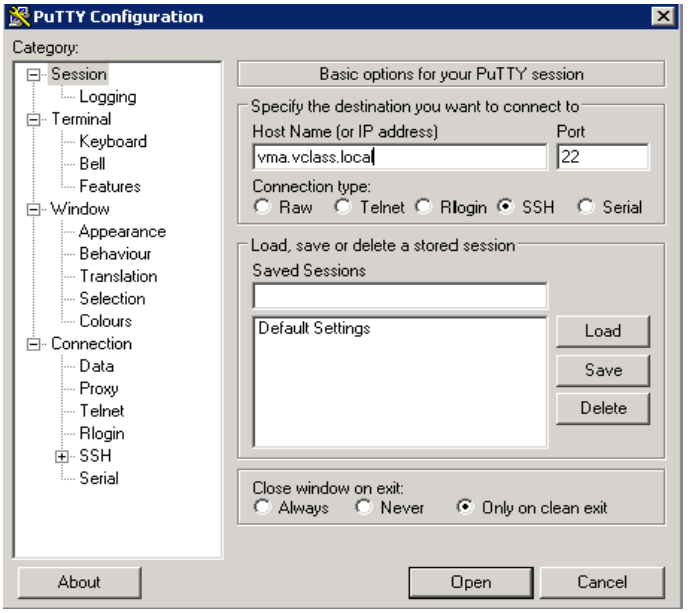
To get help on commands, use the `--help` option. Examples:

```
esxcli --help
```

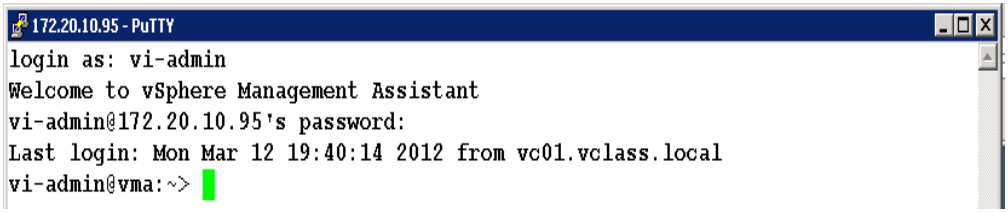
```
vifp --help
```

```
vifptarget --help
```

1. On your vCenter Server desktop, start a PuTTY session by double-clicking the **PuTTy** icon. The PuTTY Configuration dialog box is displayed.
2. In the **Host Name (or IP address)** field, enter the vMA system name that you recorded in "Preparing for the lab." Click **Open**. If a PuTTY Security Alert window is displayed, click **Yes**.



3. At the login prompt, enter the vMA user name and vMA password that you recorded in "Preparing for the lab." When you are logged in, you are placed at the vMA command prompt.



4. Add your vCenter Server system as a target server. Type the following vMA command line:

   `vifp addserver <server> --authpolicy fpauth --username <user>`

   Replace <server> with the vCenter Server system name that you recorded in "Preparing for the lab." Replace <user> with "administrator."

   a. When prompted for the password, enter the Administrator password that you recorded in "Preparing for the lab."

   b. When asked to store the user name and password in the credential store, type **`yes`**.

5. Repeat step 4 but replace <server> with the ESXi host name that you recorded in "Preparing for the lab." Also, replace <user> with "root."

   a. When prompted for the password, enter the root password that you recorded in "Preparing for the lab."

6. Verify that the target servers were added properly:

   `vifp listservers`

   You should see your vCenter Server system and your ESXi host in the list.

7. Set the target server for commands:

   `vifptarget -s <server>`

   Replace <server> with the ESXi host name that you recorded in "Preparing for the lab."

   After running the command, notice that the name of your ESXi host is displayed as part of the command prompt.

8. Verify that vMA is configured correctly by running a vMA command. Run a command to display the virtual network interface cards (NICs):

   esxcli network nic list

   You should see the results of the command, which is a list of virtual NICs as well as detailed information for each NIC.

   NOTE

   You learn more about vMA network commands in Lab 7, “Command-Line Network Management.”

   Remain logged in to vMA.

Task 6: Use esxcli commands to retrieve information about an ESXi host

In this task, you will use the vMA command line to retrieve information about your ESXi host and your running virtual machine processes. Students should do the steps in this task individually.

1. Examine the CPUs on the ESXi host:

   esxcli hardware cpu list

2. Examine the memory on the ESXi host:

   esxcli hardware memory get

3. Determine the platform on which the ESXi software is installed:

   esxcli hardware platform get

4. Examine the time and date on the host:

   esxcli hardware clock get

5. Get the systems host name:

   esxcli system hostname get

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

   esxcli system version get

7. Get the systems boot device:

   esxcli system boot device get

8. List all running virtual machine processes:

   esxcli vm process list

   Remain logged in to vMA.

Task 7: Use vicfg commands to configure NTP

In this task, you will use the vMA command line and `vicfg` commands to retrieve information about the ESXi host. Students should do the steps in this task individually.

1. List the configured NTP servers.

   `vicfg-ntp --list`

   Record the name or IP address of the configured NTP server here: _____

2. Stop the NTP service.

   `vicfg-ntp --stop`

3. Delete the NTP server, whose name or IP address you recorded in step 1.

   `vicfg-ntp --delete <NTP_server>`

4. Verify that the NTP server was deleted:

   `vicfg-ntp --list`

5. Add an NTP server whose name or IP address that you recorded in "Preparing for the lab."

   `vicfg-ntp --add <NTP_server>`

6. List the configured NTP server:.

   `vicfg-ntp --list`

7. Start the NTP service.

   `vicfg-ntp --start`

   Remain logged in to vMA.

Task 8: Use vmware-cmd to manage virtual machines

In this task, you will use the `vmware-cmd` command to manage the power state and manage snapshots on virtual machines. Students should do the steps in this task individually.

1. Print the help message that lists the options for `vmware-cmd`.

   `vmware-cmd --help`

   You can also print the help message information one screen at a time with the following command:

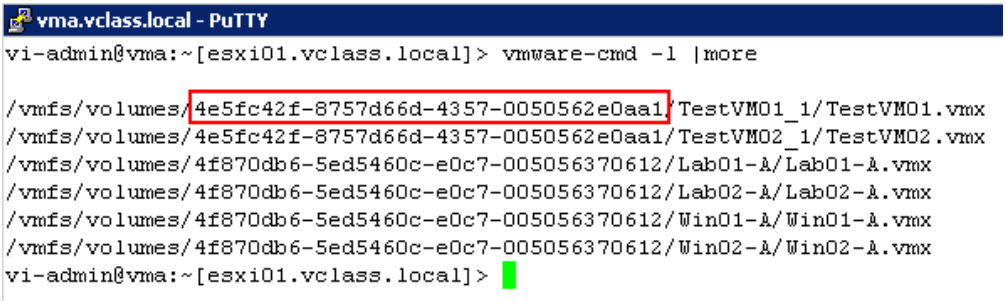
   `vmware-cmd --help | more`

   Press the space bar to scroll one screen at a time. You can also press Return to scroll one line at a time. Press **`q`** to end the command.

2. List the path names to the configuration files of all virtual machines that are registered with target server.

   `vmware-cmd -l | more`

   For example, if the target server is esxi01.vclass.local, the list of configuration file path names might look something like this:



   Notice the third directory (folder) in the path. This directory is the UUID of the file system on which the virtual machine configuration file is located.

3. Determine the mapping between the UUID and the user-friendly file system name by using the `esxcli` command.

   `esxcli storage filesystem list`

   The first column in the command output displays the mount point and the second column displays the volume name. The mount point name contains the UUID and the volume name is the user-friendly file system name.

4. Get the execution state of a Windows virtual machine.

   `vmware-cmd <vmxpath> getstate`

   Replace **`<vmxpath>`** with the path to the Windows virtual machine .vmx file that you recorded in “Preparing for the lab.”

5. If the virtual machine state is not powered on (that is, getstate() = off), power on the virtual machine.

   TIP

   To decrease the amount of typing, press the up arrow key to display the last command entered. Continue to press the up arrow key to display previous commands entered. When you find the desired command, use the backspace key, or the left and right arrow keys to modify the command line.

   ```
   vmware-cmd <vmxpath> start
   ```

   Replace **<vmxpath>** with the path to a Windows virtual machine .vmx file that you recorded in "Preparing for the lab."

6. Verify that your Windows virtual machine is powered on by listing all the running virtual machine processes:

   ```
   esxcli vm process list
   ```

7. Retrieve the platform information of the virtual machine.

   ```
   vmware-cmd <vmxpath> getproductinfo platform
   ```

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

   ```
   vmware-cmd <vmxpath> getuptime
   ```

9. Determine whether VMware® Tools™ is installed on the virtual machine. The command returns 0 if VMware Tools is not installed or not running. The command returns 1 if the guest operating system is responding normally.

   ```
   vmware-cmd <vmxpath> gettoolslastactive
   ```

10. Power off the virtual machine.

    ```
    vmware-cmd <vmxpath> stop soft
    ```

11. Verify that the virtual machine is powered off by getting the execution state of the virtual machine.

    ```
    vmware-cmd <vmxpath> getstate
    ```

12. Power on the virtual machine that you powered off in the previous step. Wait for the virtual machine to start.

    ```
    vmware-cmd <vmxpath> start soft
    ```

13. Verify that the virtual machine is powered on.

    ```
    vmware-cmd <vmxpath> getstate
    ```

14. Create a snapshot for the virtual machine.

    ```
    vmware-cmd <vmxpath> createsnapshot VMSnap<your_initials> “Test snapshot” 0 0
    ```

15. Verify that the virtual machine has a snapshot with the **`hassnapshot`** option. The command returns 1 if the virtual machine has a snapshot.

    ```
    vmware-cmd <vmxpath> hassnapshot
    ```

16. Remove the snapshot that you created.

    ```
    vmware-cmd <vmxpath> removesnapshots
    ```

17. Verify that the virtual machine has no snapshots (the command returns 0).

    ```
    vmware-cmd <vmxpath> hassnapshot
    ```

Keep your vMA session open for the next lab.

Lab 2

VMware Monitoring Tools

Objective: Use the vSphere Client performance charts and the resxtop command

In this lab, you will perform the following tasks:

1. Start database activity in your test virtual machine.
2. Display advanced vSphere Web Client performance charts.
3. Start esxtop.
4. Explore the esxtop screens.
5. Run resxtop in batch mode.
6. Use Windows Perfmon to display batch mode output.
7. Clean up for the next lab.

Preparing for the lab

Record the following information:

VMware® vCenter Server™ system name _____

vCenter Server Administrator password _____

VMware vSphere® Web Client _____

Your test virtual machine name _____

Root password of test virtual machine _____

Local datastore name _____

VMware vSphere® ESXi™ host name _____

VMware vSphere® Management Assistant (vMA) system name _____

vMA user name _____

vMA vi-admin password _____

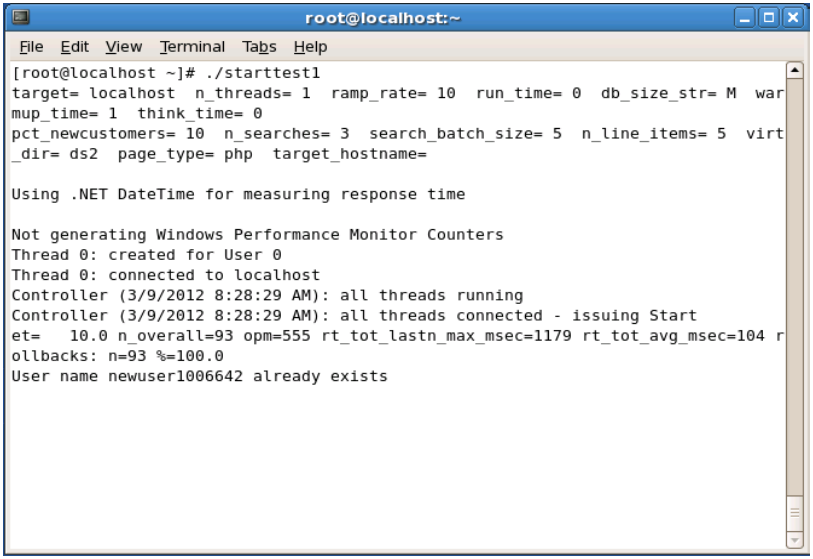
Task 1: Start database activity in your test virtual machine

In this task, you will verify that your test virtual machine is powered on and ready to use, and you will generate database activity. Students should do the steps in this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your vCenter Server system as user Administrator. You recorded the Administrator password in "Preparing for the lab."
2. Verify that your test virtual machine is powered on. You recorded your test virtual machine name in "Preparing for the lab." If your test virtual machine is not powered on, power it on now.
3. Open a console to the test virtual machine. Log in to your test virtual machine as root and open a terminal window on the desktop of the virtual machine:
   a. Right-click your test virtual machine in the inventory and select **Open Console**.
   b. Log in to your test virtual machine as root, using the root password for the test virtual machine, which you recorded in "Preparing for the lab."
   c. On the desktop of the test virtual machine, right-click the desktop and select **Open Terminal**. The terminal window is displayed.
4. In the terminal window, run the following command to start database activity:

```
# ./starttest1
```

This script generates database operations to a medium-sized database. It has been configured to run indefinitely. Allow the script to run continuously. The script writes output to the screen.



Task 2: Display advanced vSphere Web Client performance charts

In this task, you will use the vSphere Web Client to display vCenter Server overview and advanced performance charts. Students should do the steps in this task individually.

1. Open Internet Explorer and go to the vSphere Web Client page you recorded in “Preparing for the lab.”
2. Login using the administrator credentials you recorded in “Preparing for the lab.”
3. Display the overview performance charts for one of your datastores:
   a. Select **vCenter> Storage**.
   b. Expand the Training object tree and select the local datastore in the inventory. You recorded the name of the local datastore in “Preparing for the lab.”
   c. Click the **Monitor** tab and then the **Performance** button to view the overview charts for the object. Review all the charts on this screen to familiarize yourself with this pane.

      What is the total space used by virtual disks on the local datastore?

4. Display the overview performance charts for your ESXi host:
    a. Select **vCenter> Hosts**.
    b. Double-click the ESXi host that you recorded in “Preparing for the lab.”
    c. Click the **Monitor** tab and then the **Performance** button. The overview performance charts are displayed. Review all the charts on this panel to familiarize yourself with this pane.
5. Click **Advanced** to display the default advanced performance chart for your ESXi host. By default, the CPU advanced performance chart is displayed.
6. Display the memory performance chart with custom settings:
    a. Click the **Chart Options** link. The Customize Performance Chart dialog box is displayed.
    b. In the **Chart Metrics** panel, select **Memory**.
    c. In the **Chart Type** panel, click **Stacked Graph (Per VM)**.
    d. In the **Timespan** pull-down menu, select **Last day**.
    e. In the **Target Objects** panel, click **All** to select all the objects in the panel.
    f. In the **Counters** panel, click **None** to deselect all the counters in the panel. Select the counter named **Usage** and click **OK**.
    g. At the bottom of the dialog box, click **OK**. The memory performance chart displays the Memory Usage counter for each of the virtual machines as well as the ESXi host.

Task 3: Display custom vSphere Client performance charts

In this task, you will use the vSphere Client to display vCenter Server overview and advanced performance charts. Students should do the steps in this task individually.

1. Go to the vSphere Client window.
2. Display the overview performance charts for one of your datastores:
    a. Select **Home > Inventory > Datastores and Datastore Clusters**.
    b. Expand the inventory and select the local datastore in the inventory. You recorded the name of the local datastore in “Preparing for the lab.”
    c. Click the **Performance** tab to view the overview charts for this object. Review all the charts on this screen to familiarize yourself with this pane.

    What is the total space used by virtual disks on the local datastore?

3. Display the overview performance charts for your ESXi host:
   a. Select **Home > Inventory > Hosts and Clusters**.
   b. Select the ESXi host that you recorded in "Preparing for the lab."
   c. Click the **Performance** tab. The overview performance charts are displayed. Review all the charts on this panel to familiarize yourself with this pane.
4. Click **Advanced** to display the default advanced performance chart for your ESXi host. By default, the CPU advanced performance chart is displayed.
5. Display the memory performance chart with custom settings:
   a. Click the **Chart Options** link. The Customize Performance Chart dialog box is displayed.
   b. In the **Chart Options** panel, expand **Memory** and select **Past day**.
   c. In the **Chart Type** panel, click **Stacked Graph (Per VM)**.
   d. In the **Objects** panel, click **All** to select all the objects in the panel.
   e. In the **Counters** panel, click **None** to deselect all the counters in the panel. Select the counter named **Usage**.
   f. Click **Save Chart Settings**. Name the selected settings Custom-Memory-Usage. Click **OK**.
   g. At the top of the dialog box, verify that Custom-Memory-Usage appears in the **Saved Chart Settings** list.
   h. At the bottom of the dialog box, click **OK**. The memory performance chart displays the Memory Capacity Usage counter for each of the virtual machines as well as the ESXi host.
   i. In the **Switch to** list, verify that your custom chart appears in the list. If you do not see your custom chart in the list, click the **Refresh** icon for your custom chart to appear in the list.

Task 4: Start esxtop

In this task, you will start a PuTTY session to your ESXi host and start the `esxtop` command. Students should do the steps in this task individually.

1. From your desktop virtual machine, perform the following steps:
   a. Start a PuTTY session by double-clicking the **PuTTy** icon on your desktop. The PuTTY Configuration dialog box is displayed.
   b. In the **Host Name (or IP address)** field, enter the ESXi host system name that you recorded in "Preparing for the lab." Click **Open**. If a PuTTY Security Alert window is displayed, click **Yes**.
   c. At the login prompt, enter the host user name and password that you recorded in "Preparing for the lab."
2. Start the `esxtop` command by running the following command *on a single line*:

   `esxtop`

   If prompted, enter the root password of the ESXi host which you recorded in "Preparing for the lab."

   TIP

   All commands are case-sensitive. Using the wrong case will produce unexpected results.
3. Stretch the `esxtop` window horizontally so that you can see all the columns in the current screen.

Task 5: Explore the esxtop screens

In this task, you will explore the `esxtop` screens. Students should do the steps in this task individually.

1. Display the disk adapters screen: Type **`d`**.

   By default, 12 counters (columns) are displayed: ADAPTR, PATH, NPTH, CMDS/s, READS/s, WRITES/s, MBREADS/s, MBWRTN/s, DAVG/cmd, KAVG/cmd, GAVG/cmd, and QAVG/cmd.
2. Change the screen to add the counters associated with the Queue Stats category:
   a. Type **`f`** to open the field screen.
   b. Type **`d`** to enable the group of counters named QSTATS. Notice that an asterisk is placed before "D: QSTATS - Queue Stats" to indicate that this counter will be displayed.
   c. Press the space bar to return to the disk adapters screen.

What counters have been added to the screen?

3. Change the screen to remove the fields PATH and NPTH:
   a. Type **f** to open the field screen.
   b. Type **b** and **c** to disable PATH and NPATHS. Notice that the asterisks before these counter names are removed.
   c. Press the space bar to return to the disk adapters screen.

      What counters have been removed from the screen?

4. Change the screen to remove the counters associated with the Queue Stats category:
   a. Type **f** to open the field screen.
   b. Type **d** to disable the group of counters named QSTATS.
   c. Press the space bar to return to the disk adapters screen.

   What counters are displayed?

5. Display the CPU screen: Type **c**.
6. Display only the virtual machine worlds in the CPU screen: Type **V** (uppercase V).
7. Display the worlds belonging to your test virtual machine: Type **e**, enter the GID of your test virtual machine, and press Enter.
8. Return to the virtual machine worlds CPU screen: Type **e**, enter the GID of your test virtual machine again, and press Enter.
9. Change the screen to remove the counters ID, GID, and NWLD:
   a. Type **f** to open the field screen.
   b. Type **a**, **b** and **e** to disable ID, GID, and NWLD.
   c. Press the space bar to return to the disk adapters screen.

      What counters are displayed?

10. Save the screen configuration:
    a. Type **W** (uppercase W) to save the configuration.
    b. When prompted, save the file as `<your_first_name>.config`. For example, if your name is Carla, the filename is `carla.config`.
    c. Press Enter to complete the save.
    d. Type **q** to exit `resxtop`.
11. Verify the saved disk configuration:
    a. Restart `esxtop`, using the `-c` option to specify the configuration file you saved.

       For example, if your configuration filename is `carla.config` (filenames are case-sensitive), then the command to type on a single line is the following:

       ```
       $ esxtop -c carla.config
       ```

       TIP

       Instead of retyping the entire line, you can press the up arrow key to display the last command line and then modify the command line as necessary.

    b. Verify that the CPU screen is displayed and that the counters displayed match what you recorded previously.
    c. Type **d**. Verify that the disk adapters screen is displayed and that the counters displayed match what you recorded in step 4.c.
12. Type **q** to exit `esxtop`.
13. Display the manual page for `esxtop`:
    a. At the command prompt, type **`man esxtop`**. The `esxtop` manual page is displayed.
    b. Press Return to scroll down one line at a time. Familiarize yourself with the contents of this manual page. The manual page gives a brief description of the counters that appear in the different screens. You can also press the space bar to scroll down one screen at a time.
    c. Type **q** to exit the man page.

Task 6: Run resxtop in batch mode

In this task, you will run `esxtop` in batch mode and collect two minutes' worth of data. Students should do the steps in this task individually.

1. Run `esxtop` in batch mode and create a file called `~/<first_name>.csv`, where <first_name> is your first name (the tilde before the file name places the file in your home directory.) Record all statistics. Record two minutes' worth of data by using the `-n` option to take 24 samples. (The default sampling time is 5 seconds.)

For example, if your first name is Carla, then the command to type (on a single line) looks like this:

```
$ esxtop -b -a -n 24 > ~/carla.csv
```

Wait until the command prompt returns before continuing with the lab (approximately two minutes).

CAUTION

The use of the > character is destructive. If the file specified at the end of the command (for example, `~/carla.csv`) already exists, it will be overwritten with no warning message.

Task 7: Use Windows Perfmon to display batch mode output

In this task, you will use the Windows Perfmon utility to display the batch mode output generated by `esxtop`. Students should do the steps in this task individually.

1. Remotely copy your `<first_name>.csv` file from the ESXi host to your vCenter Server system:
   a. Go to your vCenter Server desktop. Double-click the WinSCP icon. The WinSCP Login dialog box is displayed.
   b. Enter the following values. When you are finished, click **Login**.

Field/setting	Value
Host name	Enter the ESXI host name, which you recorded in "Preparing for the lab."
User name	Type **`root`**.
Password	Enter the root password that you recorded in "Preparing for the lab."
Remaining fields	Keep the defaults.

   c. If a security warning message appears, click **Yes**. The WinSCP window is displayed. In the right pane, the contents of roots' home directory are displayed.
   d. In the right pane of the WinSCP window, select your CSV file and drag it to the left pane. The Copy dialog box is displayed.

      Write down the remote directory to which the file will be copied:

      _____

e. Click **Copy**. When the copy is complete, verify that the CSV file appears in the left pane of the WinSCP window.

f. In the menu bar, select **Commands** > **Quit** to exit `winscp`. Click **OK** to confirm exit.

2. Start the Perfmon application:

   a. On the desktop of the vCenter Server system, select **Start > Run**.

   b. Type **`perfmon`**. Click **OK**. The Performance window is displayed.

3. Configure Perfmon to display data from the CSV file:

   NOTE

   The following steps are specific to the Windows 2003 Performance Monitor (Perfmon). If you are using a different version of Performance Monitor (such as Windows 7 or Windows 2008), consult your instructor for the proper steps.

   a. Right-click anywhere in the graph area and select **Properties**.

   b. Click the **Source** tab.

   c. In the **Data source** panel, click **Log files**. Click **Add**.

   d. Go to the folder containing the CSV file, which you wrote down in step 1.d. Select your CSV file and click **Open**.

   e. Click the **Data** tab.

   f. In the **Counters** panel, select all the values and click **Remove**.

   g. Click **Add**.

   h. In the **Performance object** list, select **Vcpu**.

   i. Under **Select counters from the list,** select %Ready and %Used and click **Add**.

   j. Under **Select instances from the list,** select the virtual CPUs associated with your virtual machines. These entries will contain the string “vcpu” and the name of virtual machine, for example, 26:TestVM:4637:vcpu-0:TestVM. Click **Add** after selecting each virtual CPU entry.

   k. Click **Close**. The System Monitor Properties dialog box is displayed.

   l. Verify that the counters that you selected appear in the **Data** tab. Click **OK**.

4. Verify tha**t** Perfmon displays a new graph.

   Is the graph updating? Why or why not?

5. Exit Perfmon (**File** > **Exit**).

Task 8: Clean up for the next lab

In this task, you will prepare your desktop for the next lab. Students should do the steps in this task individually.

1. Remain logged in to your vCenter Server system.
2. Leave the ESXi host Putty window open.
3. Leave the vSphere Client window open.
4. Go to the console of your test virtual machine. In the terminal window, press Ctrl+C to stop the `starttest1` script.
5. Close the console window of your test virtual machine.
6. From the vSphere Client, shut down your test virtual machine.

Lab 3
vSphere Distributed Switches

Objective: Create a distributed switch

In this lab, you will perform the following tasks:

1. Configure infrastructure to use a single vCenter Server - Part I.
2. Configure infrastructure to use a single vCenter Server - Part II.
3. Create a distributed switch for the virtual machine network.
4. Create a distributed switch port group.
5. Migrate virtual machines to a distributed switch port group.
6. Verify that your virtual machine has proper access to the Production network.

Preparing for the lab

Record the following information:

VMware vSphere® ESXi™ host to partner with	_____
VMware® vCenter Server™ system to decommission	_____
ESXi host to be temporarily orphaned	_____
Team vCenter Server system name	_____
Team vCenter Server Administrator password	_____

vmnic for the Production network _____

Virtual machines to migrate _____

Windows virtual machine name _____

Virtual machine Administrator password _____

Task 1: Configure infrastructure to use a single vCenter Server - Part I

Thus far in the labs, you and your partner have been using two separate vCenter Server systems. Several of the technologies discussed in this lab and subsequent labs require that the hosts involved be managed by a single vCenter Server system.

In this task, Student B will decommission one of the vCenter Server systems. Only Student B should perform this task.

1. Use the VMware vSphere® Client™ to log in to the vCenter Server system to be decommissioned, which you recorded in "Preparing for the lab." Log in as user Administrator.

   NOTE

   Verify that you are logged in to the vCenter Server system that is being *decommissioned*.

2. Select **Home** > **Inventory** > **Hosts and Clusters**.
3. Remove your ESXi host (the temporarily orphaned host that you recorded in "Preparing for the lab") from the inventory:
   a. Right-click your ESXi host in the inventory and select **Remove**.
   b. Click **Yes** to confirm the removal.
4. Exit the vSphere Client.

   TIP

   Because this vCenter Server will not be needed in the following labs, you can optionally disable the vCenter Server service from the vCenter Server desktop. Disable the service to prevent anyone from accidentally logging in to the decommissioned vCenter Server with the vSphere Client. To disable the service, run services.msc and disable the service called "VMware VirtualCenter Server."

Task 2: Configure infrastructure to use a single vCenter Server - Part II

In this task, Student A will place the temporarily orphaned ESXi host under the control of the team vCenter Server system. Only Student A should perform this task.

1. After Student B has completed Task 1, add the orphaned ESXi host to the team vCenter Server system:

   a. Open the vSphere Client. Log in to the team vCenter Server system as user Administrator and the password that you recorded in "Preparing for the lab."

   NOTE

   Verify that you are logged in to the team vCenter Server system.

   b. Go to **Home** > **Inventory** > **Hosts and Clusters**.

   c. Expand the inventory.

   d. Right-click the Training datacenter in the inventory and select **Add Host**.

   e. When prompted by the Add Host wizard, perform the following actions.

Wizard Page	Action
Specify Connection Settings	In the **Host** field, enter the fully qualified host name of the temporarily orphaned ESXi host. In the **Username** field, type `root`. In the **Password** field, enter the root password. Click **Next**. If a security alert appears, click **Yes.**
Host Information	View the information and click **Next**.
Assign License	Select the VMware vSphere® Enterprise Plus Edition™ license key. If you see a warning message that the license key that you selected is part of another vCenter Server inventory, click **Use key**. Click **Next**.
Configure Lockdown Mode	Leave the default and click **Next**.
Virtual Machine Location	Select the Training datacenter and click **Next**.
Ready to Complete	Review the configuration summary and click **Finish.**

2. Monitor the progress of the task in the **Recent Tasks** pane. After the task is finished, the formerly orphaned ESXi host appears in the Training datacenter in the inventory.

   Remain logged in to the team vCenter Server system.

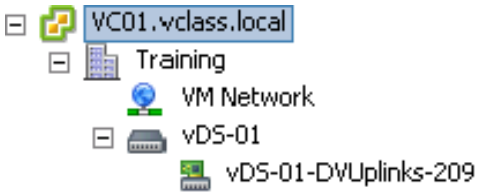
Task 3: Create a distributed switch for the virtual machine network

In this task, you will create a distributed switch named vDS-01 for virtual machine networking. Student A should do the steps in this task.

1. Select **Home** > **Inventory** > **Networking**.
2. Expand the inventory view.
3. Right-click the Training datacenter and select **New vSphere Distributed Switch**.
4. When prompted by the Create vSphere Distributed Switch wizard, perform the following actions.

Wizard Page	Action
Select vSphere Distributed Switch Version	Select **vSphere Distributed Switch Version 5.1.0**. Click **Next**.
General Properties	In the **Name** field, replace the default name with **`vDS-01`**. In the **Number of uplink ports** field, type **`2`**. Click **Next**.
Add Hosts and Physical Adapters	For **When do you want to add hosts and their physical adapters to the new vSphere distributed switch?**, click **Add now**. Under the Hosts/Physical adapters column, expand the inventory for both ESXi hosts. For each ESXi host, select the vmnic for the Production network that you recorded in “Preparing for the lab.” Click the **View details** link to view more information about the vmnic. Click **Next**.
Ready to Complete	Deselect the **Automatically create a default port group** check box. Click **Finish**.

5. Verify that the following objects are displayed in the inventory:
   - The distributed switch vDS-01
   - The uplink port group vDS-01-DVUplinks-### (where ### is a number that is assigned by vCenter Server)



Task 4: Create a distributed switch port group

In this task, each student will create his or her own distributed port group. Students should do the steps in this task individually.

1. Ensure that you are logged in to the team vCenter Server system as user Administrator. Use the password that you recorded in "Preparing for the lab."
2. Select **Home** > **Inventory** > **Networking**.
3. Right-click vDS-01 in the inventory and select **New Port Group**.
4. When prompted by the Create Distributed Port Group wizard, perform the following actions.

Wizard Page	Action
Properties	In the **Name** field, replace the default name with **`Production-<your_name>`** for the port group name, where <your_name> is your first name. Leave all other fields at their default value and click **Next**.
Ready to Complete	Click **Finish**.

5. Verify that the port group was created in the inventory.
6. Identify use cases for creating multiple port groups to access the same vmnic.

7. Select **Home** > **Inventory** > **Hosts and Clusters**.
8. Select your ESXi host from the inventory and click the **Configuration** tab.
9. Click the **Networking** link.
10. Click the **vSphere Distributed Switch** button.
11. Click the information icon to the right of vDS-01 to show distributed switch configuration details.
12. Find the name of your port group and click the information icon to the right of the port group name. This operation shows details about port group configuration.
13. In the **vDS-01-DVUplinks** pane, expand **dvUplink1** to show the vmnics in use for vDS-01 for your host.

    Do you see the vmnics for both hosts when in Hosts and Clusters view? _____

14. Select **Home** > **Inventory** > **Networking**.
15. Select vDS-01.
16. Click the **Configuration** tab.
17. In the **vDS-01-DVUplinks** pane, expand **dvUplink1** to show the vmnics in use for vDS-01 by the distributed switch.

    Do you see the vmnics for both hosts when in Networking view? _____

Task 5: Migrate virtual machines to a distributed switch port group

In this task, you will migrate your virtual machines to the port group that you created on the distributed switch. Students should do the steps in this task individually.

1. In the Networking inventory, right-click vDS-01 and select **Migrate Virtual Machine Networking**.
2. In the Migrate Virtual Machine Networking dialog box, perform the following actions.

Wizard Page	Action
Select Networks	For the source network, leave the default radio button selected and in the **Network** field, select **VM Network**. For the destination network, in the **Network** field, select **Production-<your_name> (vDS-01)**. Click **Next**.
Select VMs to Migrate	Select only the virtual machines to migrate, which you recorded in "Preparing for the lab." Select **Next**.
Ready to Complete	Click **Finish.**

3. Monitor the tasks in the **Recent Tasks** pane. Wait for the tasks to complete.
4. In the Networking inventory, select your port group (Production-YourName) and click the **Virtual Machines** tab.
5. Verify that the virtual machines that you migrated are displayed in the list.

Task 6: Verify that your virtual machine has proper access to the Production network

In this task, you will verify that your virtual machine can access the Web over the Production network. Students should do the steps in this task individually.

1. In the **Virtual Machines** tab of your Production port group, check the power state of the Windows virtual machine, whose name you recorded in "Preparing for the lab." If the virtual machine is not powered on, then power on the virtual machine. If the virtual machine is powered on, then restart the guest.

   Powering on or resetting the guest allows the virtual machine to receive an IP address from the Production network.

2. Right-click the virtual machine again and select **Open Console**.
3. Log in to the guest operating system as Administrator. Use the password that you recorded in "Preparing for the lab."
4. In Internet Explorer, go to http://www.vmware.com.
5. Verify that you can access your favorite Web site.
6. Close Internet Explorer.
7. Close the virtual machine's console.
8. Leave the vSphere Client open for the next lab.

Lab 4
Port Mirroring

Objective: Configure and use port mirroring

1. Back up the distributed switch configuration.
2. Configure port mirroring on a distributed switch.
3. Verify that port mirroring works properly.
4. Restore the distributed virtual switch configuration.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name _____

Team vCenter Server Administrator password _____

VMware vSphere® Web Client address _____

First Windows virtual machine _____

Second Windows virtual machine _____

Virtual machine Administrator password _____

Task 1: Back up the distributed switch configuration

In this task, you will back up the vDS-01 VMware vSphere® distributed switch configuration. Students should do the steps in this task as a group.

1. If the vSphere Web Client is not already active, log in to the team vCenter Server system as user Administrator. Use the password that you recorded in "Preparing for the lab."
2. Select **vCenter**> **Distributed Switches** and find your distributed switch.
3. Right-click on the distributed switch. Select **All vCenter Actions> Export Configuration...**
4. The Export Configuration wizard starts.When prompted, enter the following:.

Wizard Page	Action
Configuration to export	Select **Distributed switch and all port groups**
Description	Type **`VDS_Backup`** and click **OK**.
Confirm Configuration Export	Click **Yes**.
Select Location for download by vc01.vclass.local	Download files to **Desktop>Lab Files**. Click **Save**.

Task 2: Configure port mirroring on a distributed switch

In this task, you will configure port mirroring on the vDS-01 vSphere distributed switch. Students should do the steps in this task individually.

1. If the vSphere Web Client is not already active, log in to the team vCenter Server system as user Administrator. Use the password that you recorded in "Preparing for the lab."
2. Select **vCenter**> **VMs and Templates** and find your two Windows virtual machines, whose names you recorded in "Preparing for the lab." Ensure that both of these virtual machines are powered on.

   In the following table, record the names of these virtual machines.

First Windows virtual machine	
Second Windows virtual machine	

3. Open a console to each virtual machine. Log in to each virtual machine as user Administrator, with the Administrator password that you recorded in “Preparing for the lab.”
4. From the vSphere Web Client, double-click the source virtual machine that you recorded in “Preparing for the lab”.
5. Select the virtual machine’s **Summary** tab. In the following table, record the IP address of each virtual machine. Ensure the virtual machine is on your VMware vSphere® ESXi™ host.
6. Repeat steps 3 - 5 for the destination virtual machine your recorded in “Preparing for the lab.”

	Connectee	Port ID	IP address
Source VM			
Destination VM			

7. From the vSphere Web Client, select **vCenter**> **Distributed Switches** and double-click on the vDS-01 switch.
8. Identify the port IDs for the virtual machines that are powered on:
   a. Select the **Manage** tab and then click the **Ports** button.
   b. Scroll through the ports. Look in the **Connectee** column for the names of your source and destination virtual machine.

      TIP

      Click the **Connectee** column header to sort the ports by connectee. Your virtual machines should be displayed at the top of the list.
9. Identify one of your virtual machines to be the port mirroring source and another to be the port mirroring destination. Record the connectee and port IDs for the source and destination virtual machines.
10. Enable port mirroring on the vDS-01 distributed switch:
    a. Select the **Settings** button.
    b. Select the **Port mirroring** option.
    c. Click **New**. The Add Port Mirroring Session wizard starts.

d. When prompted by the Create Port Mirroring Session wizard, enter the following:

Wizard Page	Action
Select session type	Select **Distributed Port Mirroring**
Edit properties	In the **Name** field, type **`PortMirror-<your_name>`**. Set **Status** to **Enabled.** Change the **Normal IO on destination ports** selection box to **Allowed**. Leave the remaining check boxes unselected and click **Next**.
Select sources	Select the add port icon. From the **Select Ports** window, select the source virtual machine and click **OK**. Click **Next**.
Specify Destinations	Select the add port icon. From the **Select Ports** window, select the destination virtual machine and click **OK**. Click **Next**.
Ready to Complete	Ensure all the settings are correct and select **Finish**.

e. After the wizard finishes the configuration, verify that the port mirroring session is created and that it is enabled.

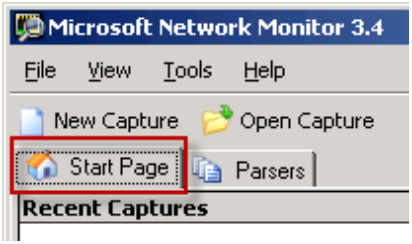
Task 3: Verify that port mirroring works properly

In this task, you will use Microsoft Network Monitor to verify that your port mirroring session is working properly. Network Monitor has been preinstalled in your virtual machines. Students should do the steps in this task individually.

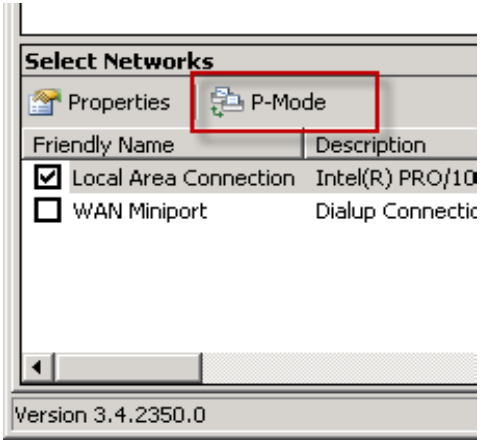
1. In the console window of both your source and destination virtual machines, start the Microsoft Network Monitor:
   a. On the virtual machine desktop, double-click the **Microsoft Network Monitor 3.4** icon.
   b. For better viewing, maximize the Network Monitor window.

2. In the console window of the *destination* virtual machine only, enable promiscuous mode in the Network Monitor:

   a. Click the **Start Page** tab, near the top left of the window.

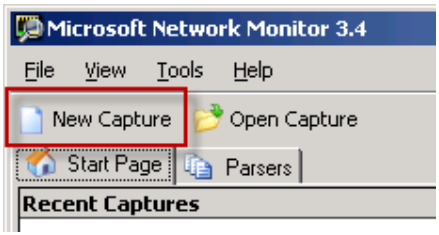


   b. Click **P-Mode**, near the bottom left of the window.

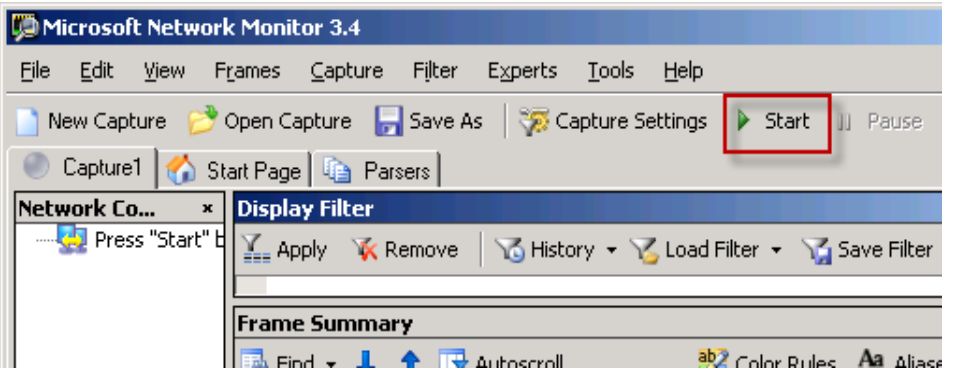


3. In both the source and the destination virtual machine console windows, start capturing packets:

   a. Click **New Capture**. The Capture1 filter is displayed.



b. In the toolbar, click **Start**.



c. In the **Frame Summary** panel, click **Autoscroll**. Slide the scroll bar to the right so that the following columns are displayed: **Source**, **Destination**, **Protocol Name**, and **Description**.

4. Start Internet Control Message Protocol (`ping`) requests from the source virtual machine and verify that the ICMP requests are mirrored on the destination virtual machine:

   a. At the source virtual machine, open a Command Prompt window by clicking **Start** >**Run**. Type **`cmd`** and press Return.

   b. Continuously ping your ESXi host from the source virtual machine. The command line to use:

      ```
      ping -t <host_name>
      ```

      An example command line:

      ```
      ping -t esxi01
      ```

   c. Verify that the ICMP requests are displayed in the Network Monitor windows of both the source and the destination virtual machines. If this is the case, port mirroring is successful.

5. When you are ready, close the Network Monitor in each console window. You do not have to save the network capture.

6. Stop the `ping` command (Ctrl+C) on the source virtual machine. Close the Command Prompt window.

7. Close the virtual machine console windows.

Task 4: Restore the distributed switch configuration

In this task, you will restore the vDS-01 vSphere distributed switch configuration. Students should do the steps in this task as a group.

1. If the vSphere Web Client is not already active, log in to the team vCenter Server system as user Administrator. Use the password that you recorded in "Preparing for the lab."
2. Select **vCenter**> **Distributed Switches** and find your distributed switch.
3. Right-click on the distributed switch. Select **All vCenter Actions> Restore Configuration...**
4. The Restore Configuration wizard starts. When prompted, enter the following:.

Wizard Page	Action
Restore Switch Configuration	Select the **Browse** button and go to **Desktop>Lab Files**. Select the backup.zip file and click **Open**. Select **Restore distributed switch and all port groups** and click **Next**,
Ready to complete	Review the import settings and select **Finish**.

Task 5: Verify the distributed virtual switch configuration

In this task, you will verify vDS-01 is restored to its original state. Students should perform this task as a group.

1. Select the distributed switch. Click the **Manage** tab, and then select **Settings > Port Monitoring**
2. Verify the configuration you entered in task 2 is no longer present.
3. Click **OK.**

Lab 5

(Optional) Designing a vSphere Distributed Switch Network Configuration

Objective: Design a network configuration for a vSphere ESXi environment, based on a set of requirements

In this lab, you will perform the following tasks:

1. Analyze the requirements.
2. Design distributed switches and physical connections.
3. Add vMotion traffic to your design.

Preparing for the lab

Based on a scenario, you design the network configuration for a VMware vSphere® ESXi™ host, specifying the following:

- Virtual switches
- Ports and port groups
- Port group policies
- Physical connections

A set of network requirements is provided. The requirements are not complete. Use your assumptions to complete those details. State your assumptions when appropriate.

NOTE

Students can do this lab individually.

Task 1: Analyze the requirements

In this task, you will analyze a set of networking requirements.

You will be the administrator in charge of configuring an ESXi host in your company's production environment. Details of the networking requirements include the following.

Virtual machines and applications

Web-based applications that are implemented by using four virtual machines, arranged as follows:

- VM1 and VM2: Web servers and network address translation (NAT) clients of VM3. They must be able to reside on any host in the configuration.
- VM3: front end for the Web servers. Acts as a NAT router for the back-end virtual machines and must be able to reside on any host in the configuration.
- VM4: a test machine, used to test intrusion detection systems and virus-protection software, among other applications.

IP-based storage

A NAS is used to hold running virtual machines for the test virtual machines only. Storage for the production virtual machines is provided by a Fibre Channel SAN.

Physical network interface cards

Four physical network adapters: two 1 Gigabit and two 10 Gigabit Ethernet cards.

External networks

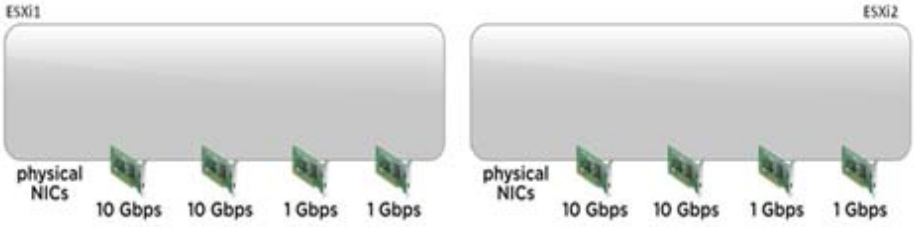
Two physical switches and four external LANs, each named to indicate its purpose. A single physical switch is configured to handle traffic for three networks, which are implemented as VLANs. One physical switch is dedicated to the management LAN, which, by company policy, must be physically separate from all other networks. The management LAN is used by VMware® vCenter Server™.

Task 2: Design distributed switches and physical connections

In this task, you will use the information in task 1 and the following diagram to draw a network configuration.

Show all virtual switches and their ports and port groups and indicate the policies to be applied to each (NIC teaming, VLANs, security, traffic shaping). Also show the connections from the virtual machines to the virtual switches as well as from the physical network interface cards (NICs) to the physical switches.

The point of this lab is not to produce the one correct answer. Many reasonable solutions are possible, so this lab encourages a discussion of the advantages and disadvantages of different solutions.



Task 3: Add vMotion traffic to your design

In this task, you will add the necessary network components to your design according to the following considerations:

- VMware vSphere® vMotion® traffic is not considered Management traffic.
- vMotion traffic is considered Management traffic.

Management has not yet decided whether vMotion traffic is considered Management traffic.

Your design might require two different solutions.

Lab 6

Monitoring Network Activity

Objective: Use performance charts and resxtop to monitor network performance

In this lab, you will perform the following tasks:

1. Start the network client and network server virtual machines.
2. Configure esxtop.
3. Perform test case 1: Measure network activity over the e1000 network adapter.
4. Modify test virtual machines to use vmxnet3.
5. Perform test case 2: Measure network activity over the vmxnet3 network adapter.
6. Perform test case 3: Measure network activity over the same network.
7. Summarize your findings.
8. Clean up for the next lab.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name	_____
Team vCenter Server Administrator password	_____
Network client test virtual machine	_____
Network server test virtual machine	_____
Root password for the test virtual machines	_____
VMware vSphere® Management Assistant (vMA) IP address	_____
vMA vi-admin password	_____
VMware vSphere® ESXi™ host name	_____
Production vmnic	_____

Task 1: Start the network client and network server virtual machines

In this task, you will start your network client test virtual machine and your network server test virtual machine. You will also ensure that these virtual machines are connected to the correct networks. Students should do the steps in this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your team vCenter Server system as user Administrator. Use the Administrator password recorded in "Preparing for the lab."
2. Select **Home** > **Inventory** > **Hosts and Clusters**.
3. Verify that your network client and network server test virtual machines are displayed in the inventory. You recorded the names of these test virtual machines in "Preparing for the lab."
4. Prepare your network client virtual machine (called "network client" for the remainder of the lab):
    a. Verify that your network client is connected to your Production port group on the vSphere distributed switch named vDS-01. To do this, select your network client in the inventory and click the **Summary** tab. The Network column should display the distributed port group named Production-<your_name>.

b. Power on your network client. (If the network client is already powered on, then restart it.)

c. While the virtual machine is powering on, open a console to your network client. To do this, right-click the virtual machine in the inventory and select **Open Console**.

   Wait for the virtual machine to boot up. Your test virtual machine runs a Linux guest operating system.

d. After your network client is fully booted, log in as user root, with the root password recorded in "Preparing for the lab."

e. From your network client's desktop, open a command-line window. To do this, right-click the your network client's desktop and select **Open Terminal**.

f. Run the following command to ensure that the network is started properly:

   ```
   # service network restart
   ```

   Leave the terminal window open. You use it later.

5. Prepare your network server virtual machine (called "network server" for the remainder of the lab):

   a. View the network server's **Summary** tab. Verify that your network server is connected to the VM Network port group.

      If your network server is not connected to the VM Network port group, then edit the virtual machine's settings to change the network connection.

   b. Power on your network server.

   c. While the virtual machine is powering on, open a console to your network server. To do this, right-click the virtual machine in the inventory and select **Open Console**.

   d. After your network server is fully booted, log in as user root, with the root password recorded in "Preparing for the lab."

   e. From your network server's desktop, open a command-line window. To do this, right-click the your network server's desktop and select **Open Terminal**.

   f. Run the following command to ensure that the network is started properly:

      ```
      # service network restart
      ```

      Leave the terminal window open. You use it later.

Task 2: Configure esxtop

In this task, you will log in to the `esxtop` utility and configure its display to show network statistics. You will also configure the display to update every 20 seconds. Students should do the steps in this task individually.

1. Go to your ESXi host PuTTy window. If you must restart your session, use the following steps:
   a. Start a PuTTY session and connect to the ESXi host, whose name you recorded in "Preparing for the lab."
   b. Log in as root, using the root password recorded in "Preparing for the lab."
2. Run the following `resxtop` command:

   `esxtop`
3. In the `esxtop` window, type **`n`** to display the network screen.
4. If necessary, stretch the `resxtop` window horizontally so that you can see all the columns.
5. Change the delay between updates from the default (5 seconds) to 20 seconds:
   a. Type **`s`**, then type **`20`**. Press Return.
   b. Verify that the screen changes after 20 seconds. You do not have to be exact, but make sure that the screen updates.

   Leave the `resxtop` window open. You will view it later.

Task 3: Perform test case 1: Measure network activity over the e1000 network adapter

In this task, you will measure the network activity between your network client and your network server. Both virtual machines are configured with the e1000 network adapter. Students should do the steps in this task individually.

1. Verify that your network client is using the e1000 virtual network adapter:
   a. In the vSphere Client window, right-click your network client in the inventory and select **Edit Settings**.
   b. In the **Hardware** tab, select Network adapter 1.
   c. Verify that the adapter type is e1000.
   d. Click **Cancel**.
   e. Perform steps a to d to verify that the network adapter on your network server is also of type e1000.

2. Start the `netserver` script on your network server:

   a. Go to your network server's console. In the terminal window on your network server's desktop, change to the `netperf` directory. To do this, type the following command at the command prompt (#) and press Enter:

      # **`cd netperf`**

   b. Start the `netserver` program. To do this, type the following command:

      # **`./netserver`**

      The screenshot below shows an example of this command's output.

```
[root@test netperf]# ./netserver
Starting netserver at port 12865
Starting netserver at hostname 0.0.0.0 port 12865 and family AF_UNSPEC
[root@test netperf]#
```

      This program runs as a background process.

   c. Verify that the `netserver` program is running. To do this, type the following `ps` and `grep` command line:

      # **`ps -ef | grep netserver`**

      The following screenshot shows an example of the command's output:

```
[root@test netperf]# ps -ef|grep netserver
root     28869     1  0 07:31 ?        00:00:00 ./netserver
root     29108 28709  0 07:40 pts/2    00:00:00 grep netserver
[root@test netperf]#
```

      The first line in the output shows you that the `netserver` process is running.

3. Determine the IP address of your network server:

   # **ifconfig**

```
[root@localhost netperf]# ifconfig
eth0      Link encap:Ethernet  HWaddr 00:50:56:AA:6A:B2
          inet addr:172.20.10.100  Bcast:172.20.10.255  Mask:255.255.255.0
          inet6 addr: fe80::250:56ff:feaa:6ab2/64 Scope:Link
          UP BROADCAST RUNNING MULTICAST  MTU:1500  Metric:1
          RX packets:45 errors:0 dropped:0 overruns:0 frame:0
          TX packets:55 errors:0 dropped:0 overruns:0 carrier:0
          collisions:0 txqueuelen:1000
          RX bytes:5772 (5.6 KiB)  TX bytes:9710 (9.4 KiB)
          Base address:0x2000 Memory:d8920000-d8940000
```

   Record the IP address associated with the eth0 interface: _____

4. Start the regular throughput network test script on your network client:

   a. Go to your network client's console. In the terminal window on your network client's desktop, change to the `netperf` directory:

      # **cd netperf**

   b. Start the test program, `nptest1.sh`:

      # **./nptest1.sh <IP_address>**

      where <IP_address> is the IP address of your network server.

```
[root@localhost ~]# cd netperf
[root@localhost netperf]# ./nptest1.sh 172.20.10.104

===> This script runs for 60 minutes before exiting.  Please do not interrupt it
 unless instructed to do so.

TCP STREAM TEST from 0.0.0.0 (0.0.0.0) port 0 AF_INET to 172.20.10.104 (172.20.1
0.104) port 0 AF_INET
```

5. Go to the `esxtop` window. Allow the screen to update at least once.

6. Using the tables at the end of this lab, record the following data:

   a. For your Production vmnic, which you recorded in "Preparing for the lab," record the values for MbTX/s, MbRX/s, %DRPTX, and %DRPRX. To do this, view the entry in the `esxtop` window where the value in the USED-BY column is the vmnic used by the Production port group. In the following example, vmnic1 is the Production vmnic.

```
 9:31:42pm up 6 days  3:25, 317 worlds, 2 VMs, 3 vCPUs; CPU load average: 0.28, 0.28, 0.29
Current Field order: AbcDEFGHIJKLmno
```

PORT-ID	USED-BY	TEAM-PNIC	DNAME	PKTTX/s	MbTX/s	PKTRX/s
16777217	Management	n/a	vSwitch0	0.00	0.00	0.00
16777218	vmnic0	-	vSwitch0	5406.31	2.81	26063.70
16777219	vmk0	vmnic0	vSwitch0	11.52	0.09	8.89
16777226	357625:TestVM02	vmnic0	vSwitch0	5394.79	2.72	26051.89
33554435	Management	n/a	DvsPortset-0	0.00	0.00	0.00
33554436	vmnic1	-	DvsPortset-0	5394.49	285.14	5394.74
33554443	357663:TestVM01.eth0	vmnic1	DvsPortset-0	5394.49	285.14	5394.74

   Record these values in table 1, in the Test 1 column.

   b. For your network client, record the values for MbTX/s, MbRX/s, %DRPTX, and %DRPRX. To do this, view the entry in the `esxtop` network screen where the value in the USED-BY column contains the name of your network client. In the following example, 4248:VMTest01 contains the name of your network client:

```
vi-admin@vma3-instructor:~
 8:21:35am up  1:12, 129 worlds; CPU load average: 0.20, 0.21, 0.20
```

PORT-ID	USED-BY	TEAM-PNIC	DNAME	PKTTX/s	MbTX/s	PKTRX/s	MbRX/s	%DRPTX	%DRPRX
16777217	Management	n/a	vSwitch0	0.00	0.00	0.00	0.00	0.00	0.00
16777218	vmnic0	-	vSwitch0	8514.41	4.32	16813.04	179.77	0.00	0.00
16777219	4096:vswif0	vmnic0	vSwitch0	10.55	0.03	1.83	0.00	0.00	0.00
16777220	4252:VMTest02	vmnic0	vSwitch0	8502.28	4.28	16804.32	180.25	0.00	0.00
16777222	4291:vma-koala03	vmnic0	vSwitch0	1.53	0.00	2.72	0.02	0.00	0.00
33554433	Management	n/a	vSwitch1	0.00	0.00	0.00	0.00	0.00	0.00
33554434	vmnic1	-	vSwitch1	8418.15	175.52	8502.87	4.28	0.00	0.00
33554435	4248:VMTest01	vmnic1	vSwitch1	8418.01	175.51	8502.33	4.54	0.00	0.00

   Record these values in table 2, in the Test 1 column.

7. Stop the `nptest1.sh` network test. To do this, go to your network client's console and press Ctrl+C in the terminal window.

Task 4: Modify test virtual machines to use vmxnet3

In this task, you will modify your network client and your network server to use the vmxnet3 network adapter. Students should do the steps in this task individually.

1. Modify your network client and your network server to use vmxnet3:
   a. Right-click your network client in the inventory and select **Edit Settings**.
   b. In the **Hardware** tab, select Network adapter 1. Click **Remove**.
   c. Click **Add.** The Add Hardware wizard appears.
   d. When prompted by the Add Hardware wizard, perform the following actions:

Wizard page	Action
Device Type	Select **Ethernet Adapter** and click **Next.**
Network Type	In the **Type** field, select VMXNET 3. In the **Network label** field, select your Production port group for the network client. For the network server, select the VM Network port group. Leave the **Connect at power on** check box selected. Click **Next**.
Ready to Complete	Click **Finish**.

   e. Verify that the new network interface card (NIC) shows up in **Hardware** tab.
   f. In the Virtual Machine Properties dialog box, click **OK**.
   g. Perform steps a to f to modify the network adapter of your network server to use vmxnet3 —with the following exception. For the **Network label** field, select VM Network instead of Production.
2. In the terminal window of both the network client and the network server, enable each virtual machine to access external networks by running the following command:

```
# service network restart
```

Task 5: Perform test case 2: Measure network activity over the vmxnet3 network adapter

In this task, you will measure the network activity between your network client and your network server. Both virtual machines are configured with the vmxnet3 network adapter. Students should do the steps in this task individually. If netserver is not already running, perform the following steps:

1. Start the `netserver` script on your network server:
   a. View your network server's console. In the terminal window on your network server's desktop, change to the `netperf` directory:

      # **cd netperf**

   b. Start the `netserver` program:

      # **./netserver**

   c. Verify that the `netserver` program is running:

      # **ps -ef | grep netserver**

2. Determine the IP address of your network server:

   $ **ifconfig**

   Record the IP address associated with the eth0 interface: _____

3. Start the regular throughput network test script on your network client:
   a. Go to your network client's console. In the terminal window on your network client's desktop, change to the `netperf` directory:

      $ **cd netperf**

   b. Start the test program, `nptest1.sh`:

      $ **./nptest1.sh <IP_address>**

      where <IP_address> is the IP address of your network server.

4. Go to the `resxtop` window. Allow the screen to update at least once.
5. Using the tables at the end of this lab, record the following data:
   a. For your Production vmnic, which you recorded in "Preparing for the lab," record the values for MbTX/s, MbRX/s, %DRPTX, and %DRPRX. To do this, view the entry in the `resxtop` window where the value in the USED-BY column is the vmnic used by the Production port group. Record these values in table 1, in the Test 2 column.
   b. For your network client, record the values for MbTX/s, MbRX/s, %DRPTX, and %DRPRX. Record these values in table 2, in the Test 2 column.
6. Stop the `nptest1.sh` network test (press Ctrl+C in the terminal window.)

Task 6: Perform test case 3: Measure network activity over the same network

In this task, you will connect your network client and your network server to the Production port group. You will then measure network activity between these two virtual machines. Both virtual machines are configured with a vmxnet3 network adapter. Students should do the steps in this task individually.

1. Modify your network server to use the Production port group:
   a. In the vSphere Client window, right-click your network server in the inventory and select **Edit Settings**.
   b. In the **Hardware** tab, select Network adapter 1.
   c. In the **Network label** field, select **vDS-01 (Production-<your_name>)**. Click **OK**.
2. Release and renew the IP address for your network server:
   a. Go to your network server's console.
   b. In the terminal window, run the following commands:

      # **dhclient -r**
      # **dhclient**

      The first command line releases the IP address. The second command line renews the IP address.
3. Determine the new IP address of your network server:

   # **ip addr**

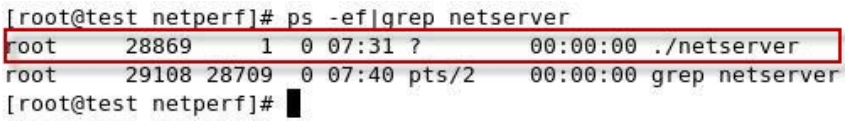
   Record the IP address associated with the eth0 interface: _____

   The command output will look similar to this:

```
[root@localhost netperf]# ip addr
1: lo: <LOOPBACK,UP,LOWER_UP> mtu 16436 qdisc noqueue
    link/loopback 00:00:00:00:00:00 brd 00:00:00:00:00:00
    inet 127.0.0.1/8 scope host lo
    inet6 ::1/128 scope host
       valid_lft forever preferred_lft forever
2: eth0: <BROADCAST,MULTICAST,UP,LOWER_UP> mtu 1500 qdisc pfifo_fast qlen 1000
    link/ether 00:50:56:aa:54:e0 brd ff:ff:ff:ff:ff:ff
    inet 172.20.10.100/24 brd 172.20.10.255 scope global eth0
    inet6 fe80::250:56ff:feaa:54e0/64 scope link
       valid_lft forever preferred_lft forever
```

4. Stop the running instance of the `netserver` script on your network server:
   a. In the terminal window, run the following `ps` and `grep` command line:

      # **ps -ef | grep netserver**

      Record the number following the name root on the line ending in `./netserver`: _____

      In the preceding example, the number you would record is 28869.

   b. Using the value that you recorded in the previous step, use the `kill` command to stop the `netserver` program:

      # **kill <value_from_step_4a>**

5. Restart the `netserver` script on your network server:

   # **./netserver**

6. Start the low throughput test on your network client:
   a. Go to your network client's console.
   b. Start the test program, `nptest1.sh`:

      $ **./nptest1.sh <IP_address>**

      where <IP_address> is the IP address of your network server.

7. Go to the `esxtop` window. Allow the screen to update at least once.
8. Using the tables at the end of this lab, record the following data:
   a. For your Production vmnic, which you recorded in "Preparing for the lab," record the values for MbTX/s, MbRX/s, %DRPTX, and %DRPRX. To do this, view the entry in the `resxtop` window where the value in the USED-BY column is the vmnic used by the Production port group. Record these values in table 1, in the Test 3 column.
   b. For your network client, record the values for MbTX/s, MbRX/s, %DRPTX, and %DRPRX. Record these values in table 2, in the Test 3 column.
9. Stop the `nptest1.sh` network test (press Ctrl+C in the terminal window.)

Task 7: Summarize your findings

In this task, you will summarize your findings. Students should do the steps in this task individually.

View the tables at the end of this lab. What conclusions can you draw from the data that you recorded? Your instructor will review the results with you.

Task 8: Clean up for the next lab

In this task, clean up your desktop to prepare for the next lab. Students should do the steps in this task individually.

1. Shut down your network client and your network server. In the inventory, right-click the virtual machine and select **Power** > **Shut Down Guest**.
2. In the `resxtop` window, press Ctrl+C to exit `esxtop`.

   Close the consoles to the network client and network server.

   Leave the ESXi host PuTTY window open.

   Leave the vSphere Client window open.

Table 1: esxtop Counters for the Production vmnic

Counters for Production vmnic	Test 1 VMs using e1000, different networks, nptest1.sh	Test 2 VMs using vmxnet3, different networks, nptest1.sh	Test 3 VMs using vmxnet3, same network, nptest1.sh
MbTX/s			
MbRX/s			
%DRPTX			
%DRPRX			

Table 2: esxtop Counters for your Network Client VM

Counters for your network client	Test 1 VMs using e1000, different networks, nptest1.sh	Test 2 VMs using vmxnet3, different networks, nptest1.sh	Test 3 VMs using vmxnet3, same network, nptest1.sh
MbTX/s			
MbRX/s			
%DRPTX			
%DRPRX			

Lab 7

Command-Line Network Management

Objective: Use vMA and other commands to manage networking

In this lab, you will perform the following tasks:

1. View your virtual switch configuration.
2. Examine .vmx file entries related to the network configuration.
3. Examine net-dvs output.

Preparing for the lab

Record the following information:

VMware vSphere® Management Assistant (vMA) system name _____

vMA vi-admin password _____

VMware vSphere® ESXi™ host name _____

ESXi host root password _____

Virtual machine configuration file path _____

Virtual machine configuration filename _____

Task 1: View your virtual switch configuration

In this task, you will use the vMA command line to list information about your virtual network interface cards (NICs), standard switches, and distributed switches. Students should do the steps in this task individually.

1. Go to your vMA window. If you must restart your vMA session, use the following steps:
   a. Start a PuTTY session and connect to the vMA system whose name you recorded in "Preparing for the lab."
   b. Log in as vi-admin by using the vi-admin password recorded in "Preparing for the lab."
2. In the vMA window, list each virtual NIC:

   ```
   esxcli network nic list
   ```

   Notice that with this information, you can relate the virtual NIC to physical NIC information.
3. List each standard switch and its properties:

   ```
   esxcli network vswitch standard list
   ```

   TIP

   To avoid a lot of typing, press the Up Arrow key to display the last command and modify the command line.
4. List each distributed switch and its properties:

   ```
   esxcli network vswitch dvs vmware list
   ```
5. List all IPv4 VMkernel interfaces:

   ```
   esxcli network ip interface ipv4 get
   ```
6. Determine if IPv6 is enabled for your VMkernel interfaces:

   ```
   esxcli network ip interface ipv6 get
   ```
7. List each VMkernel interface and its properties:

   ```
   esxcli network ip interface list
   ```
8. Use the `esxcfg-vswitch` command to list information about your virtual switches:

   ```
   esxcfg-vswitch -l
   ```

   On which vSwitch is your management network located? _____

   Which vmnic adapter is used for your VMware vSphere® vMotion® port group? _____

   Which vmnic adapter is used in the distributed switch? _____

   Minimize your vMA window.

Task 2: Examine .vmx file entries related to the network configuration

In this task, you will examine the `.vmx` file for a virtual machine to relate `.vmx` settings to the virtual machine network configuration. Students should do the steps in this task individually.

1. From your VMware® vCenter Server™ desktop, start another PuTTY session by double-clicking the **PuTTy** icon. Connect to your ESXi host. Log in as root and the root password that you recorded in "Preparing for the lab."
2. Display the contents of a virtual machine configuration file:
   a. Change to the directory where the virtual machine configuration file is located:

      `cd <VM_config_file_path>`

      Replace <VM_config_file_path> with the virtual machine configuration file path that you recorded in "Preparing for the lab."

   b. Display the lines in the virtual machine configuration file that contain the keyword "ethernet0":

      `grep ethernet0 <VM_config_file_name>`

      Replace <VM_config_file_name> with the virtual machine configuration filename that you recorded in "Preparing for the lab."

      Some of the lines that are displayed look similar to the following:

```
ethernet0.dvs.switchId = "64 63 2a 50 a9 5a 9c 01-0c 49 dc 7c 9a 83 74 b4"
ethernet0.dvs.portId = "102"
ethernet0.dvs.portgroupId = "dvportgroup-211"
ethernet0.dvs.connectionId = "540775374"
```

   Record the following values here:

   ethernet0.dvs.switchId (just the first few numbers): _____

   ethernet0.dvs.portId: _____

   ethernet0.dvs.portgroupId: _____

   ethernet0.dvs.connectionId: _____

Task 3: Examine net-dvs output

In this task, you will use the `net-dvs` command to view information about your distributed switch. You will then relate that information to your virtual machine. Students should do the steps in this task individually.

1. Maximize the PuTTY window to your ESXi host.
2. In the PuTTY window, run the `net-dvs` command and pipe it to the `more` command:

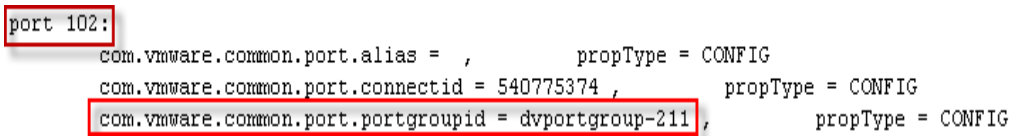
   `net-dvs | less`
3. View the first line of the `net-dvs` command output. This line displays the switch ID, which should match the switch ID that you recorded in task 2.

   Also notice the com.vmware.common.alias field, which is a few lines down. This field is set to the name of the distributed switch.
4. Press Return to scroll through the output one line at a time.

   TIP

   In addition to pressing Return, you can also press Ctrl+f to scroll forward one screen at a time, and Ctrl+b to scroll backward one screen at a time.

   Search the file for port ID and port group ID that you recorded in task 2. (More than one port group ID might exist.) The port and port group ID information looks similar to the following:



   For your port, view the port statistics (com.vmware.common.port.statistics). This information can be extremely useful in troubleshooting. Pay careful attention to fields like `pktsInDropped` and `pktsOutDropped`. These fields can be used to indicate some type of hardware problem or physical network overload.

   This section also reports on 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 in general (CPU, RAM, and so on)
5. End the `net-dvs` command by scrolling to the end of the command's output, or by pressing **`q`** to quit the more command.
6. Type **`exit`** to end the PuTTY session to your ESXi host.

Leave your vMA session window open.

Lab 8
Profile-Driven Storage

Objective: Work with profile-driven storage

In this lab, you will perform the following tasks:

1. Create a VMFS datastore configuration for this lab.
2. Create a user-defined storage capability.
3. Create a virtual machine storage profile.
4. Enable your host to use virtual machine storage profiles.
5. Associate storage profiles with virtual machines.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name	_____
Team vCenter Server Administrator password	_____
Target number and logical unit number (LUN) ID for your Gold Tier storage	_____
Target number and LUN ID for your Silver Tier storage	_____
First Windows virtual machine name	_____
Second Windows virtual machine name	_____

Task 1: Create a VMFS datastore configuration for this lab

In this task, you will create two VMware vSphere® VMFS (VMFS) datastores, named Gold Tier and Silver Tier. Then, you will migrate your Windows virtual machines to your Silver Tier datastore. Students should do the steps in this task individually.

1. If the VMware vSphere® Client™ is not already active, log in to the team vCenter Server system as user Administrator. Use the password that you recorded in "Preparing for the lab."
2. Select **Home** > **Inventory** > **Hosts and Clusters**.
3. Create a VMFS-5 datastore named GoldTier-<your_name>:
   a. Select your VMware vSphere® ESXi™ host in the inventory and click the **Configuration** tab.
   b. Click the **Storage** link.
   c. Click the **Add Storage** link. The Add Storage wizard starts.
   d. In the **Select Storage Type** page, keep **Disk/LUN** selected and click **Next**.
   e. In the **Select Disk/LUN** page, expand the **Path ID** column so that you can see the target number (tgt#) at the end of the path ID. Select the LUN (for your Gold Tier storage) whose target number and LUN ID you recorded in "Preparing for the lab." Click **Next**.
   f. In the File System Version page, keep **VMFS-5** selected and click **Next**.
   g. In the Current Disk Layout page, view the information and click Next.
   h. In the Properties page, type the datastore name **`GoldTier-<your_name>`**. Example: GoldTier-Mike.
   i. In the Disk/LUN - Formatting page, keep the default capacity and click **Next**.
   j. In the Ready to Complete page, click **Finish**.
4. Perform the steps in step 3 to create a VMFS-5 datastore named SilverTier-<your_name>, with one change:
   a. On the **Select Disk/LUN** page, select the LUN for your Silver Tier storage, whose target number and LUN ID you recorded in "Preparing for the lab."
5. Use VMware vSphere® Storage vMotion® to migrate your two Windows virtual machines to your Silver Tier datastore. You recorded the Windows virtual machine names in "Preparing for the lab."
   a. Right-click the virtual machine, then select **Migrate**. The Migrate Virtual Machine wizard appears.
   b. In the Select Migration Type page, select **Change datastore** and click **Next**.
   c. In the Storage page, select your Silver Tier datastore and click **Next**.

d. In the Ready to Complete page, click **Finish**.

e. View the **Summary** tab of each Windows virtual machine to verify that it has been migrated to your Silver Tier datastore.

Task 2: Create a user-defined storage capability

In this task, you will create a user-defined storage capability named Gold Tier. You will assign this capability to one of your datastores. Students should do the steps in this task individually.

1. Go to the Datastores and Datastore Clusters inventory view (**Home** > **Inventory** > **Datastores and Datastore Clusters**).
2. Select your Gold Tier datastore and click the **Summary** tab.
3. In the **Storage Capabilities** panel, notice that no user-defined storage capabilities exist for this datastore.
4. Right-click your Gold Tier datastore and select **Assign User-Defined Storage Capability**. The Assign User-Defined Storage Capability dialog box is displayed.
5. In the dialog box, click **New**. The Add Storage Capability dialog box is displayed.
6. In the **Name** field, type **`Gold Tier-<your_name>`**.
7. In the **Description** field, type **`Top-class storage`**.
8. Click **OK**. Click **OK** again to save this capability.
9. Verify that the user-defined storage capability has been assigned to this datastore. Click the **Refresh** link to update the display.
10. Click the callout icon next to the user-defined storage capability. This icon displays the name and description of the capability.
11. Repeat steps 4–10 to create another user-defined storage capability named Silver Tier-<your_name>. Assign this capability to your Silver Tier datastore. Give it a description of your choice.

Task 3: Create a virtual machine storage profile

In this task, you will create a virtual machine storage profile named Gold Storage Profile. Students should do the steps in this task individually.

1. Go to the Home page of the vSphere Client.
2. In the Home page, click the **VM Storage Profiles** icon.
3. In the toolbar, click **Create VM Storage Profile**.

4. When prompted by the Create New VM Storage Profile wizard, perform the following actions.

Field/Setting	Action
Name	Type **`Gold Storage Profile - <your_name>`**.
Description	Type **`Ensure that top-class VMs reside on Gold Tier storage`**. Click **Next**.
Storage Capabilities	Select your Gold Tier storage capability and click **Next**.
Ready to complete the VM Storage Profile	View the storage profile information. Click **Finish**.

5. Verify that your storage profile is displayed in the VM Storage Profiles inventory.
6. Select your Gold Storage Profile in the inventory and click the **Summary** tab.
7. In the **General** panel, notice that no virtual machines are associated with this profile.
8. Create another virtual machine storage profile. In the toolbar, click **Create VM Storage Profile**.
9. When prompted by the Create New VM Storage Profile wizard, perform the following actions.

Field/Setting	Action
Name	Type **`Silver Storage Profile - <your_name>`**.
Description	Type a description of your choice. Click **Next**.
Storage Capabilities	Select your Silver Tier storage capability and click **Next**.
Ready to complete the VM Storage Profile	View the storage profile information. Click **Finish**.

10. Verify that your storage profile is displayed in the VM Storage Profiles inventory.

Task 4: Enable your host to use virtual machine storage profiles

In this task, you will enable your host to use virtual machine storage profiles. Students should do the steps in this task individually.

1. In the toolbar, click **Enable VM Storage Profiles**. The Enable VM Storage Profiles dialog box is displayed.
2. In the **Hosts and Clusters** panel, select your ESXi host and click the **Enable** link.
3. Under the VM Storage Profile Status column, verify that the status is Enabled for your ESXi host. Click **Close**.

Task 5: Associate storage profiles with virtual machines

In this task, you will associate storage profiles with your Windows virtual machines. Students should do the steps in this task individually.

1. Select **Home** > **Inventory** > **Hosts and Clusters**.
2. Right-click your first Windows virtual machine, whose name you recorded in "Preparing for the lab," then select **VM Storage Profile** > **Manage Profiles**. The Virtual Machine Properties dialog box is displayed. The **Profiles** tab is displayed.
3. From the **Home VM Storage Profile** list, select your Silver Storage profile.
4. Click **Propagate to disks** to apply the virtual machine storage profile to the virtual disk. Your Silver Storage profile is listed next to the virtual disk.
5. Click **OK**.
6. Select your first Windows virtual machine in the inventory and click the **Summary** tab.
7. In the **VM Storage Profiles** panel, verify that the virtual machine is storage compliant. You might have to click the **Refresh** link first.
8. In the inventory, right-click your second Windows virtual machine and select **VM Storage Profile** > **Manage Profiles**. You recorded the name of your second Windows virtual machine in "Preparing for the lab." The Virtual Machine Properties dialog box appears.
9. From the **Home VM Storage Profile** list, select your Gold Storage profile.
10. Click **Propagate to disks** to apply the virtual machine storage profile to the virtual disk. Your Gold Storage profile is listed next to the virtual disk.
11. Click **OK**.
12. Select your second Windows virtual machine in the inventory and click the **Summary** tab.
13. In the **VM Storage Profiles** panel, notice that the virtual machine is noncompliant. You might have to click the **Refresh** link first.

14. Click the **Noncompliant** link. The compliance failure lists “Capability mismatch.”

    Why is there a capability mismatch?

15. Use Storage vMotion to bring your second Windows virtual machine into compliance:
    a. Right-click your second Windows virtual machine in the inventory and select **Migrate**.
    b. When prompted by the Migrate Virtual Machine wizard, perform the following actions.

Wizard page	Action
Select Migration Type	Select **Change datastore** and click **Next**.
Select a virtual disk format	Leave the **Same format as source** selected.
VM Storage Profile	In the **VM Storage Profile** field, select your Gold Storage profile. Notice that your Gold Tier datastore is listed under **Compatible**. All other datastores are listed under **Incompatible**. Click **Next**.
Ready to Complete	Click **Finish**.

16. After the migration is complete, click the **Refresh** link in the **VM Storage Profiles** panel. Your second windows virtual machine should now be compliant.

Leave the vSphere Client open for the next lab.

Lab 9

Managing Datastore Clusters

Objective: Create a datastore cluster and configure Storage DRS

In this lab, you will perform the following tasks:

1. Create a datastore cluster enabled for Storage DRS.
2. Perform a datastore evacuation with datastore maintenance mode.
3. Manually run Storage DRS and apply migration recommendations.
4. Acknowledge Storage DRS alarms.
5. Clean up for the next lab.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name _____

Team vCenter Server Administrator password _____

Task 1: Create a datastore cluster enabled for Storage DRS

In this task, you will create a datastore cluster that is enabled for VMware vSphere® Storage DRS™. You will verify that the datastores in the datastore cluster have the proper virtual machine configuration. Students should perform this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your team vCenter Server system as user Administrator. Use the password that you recorded in "Preparing for the lab."
2. Select **Home** > **Inventory** > **Datastores and Datastore Clusters**.
3. Right-click the Training datacenter and select **New Datastore Cluster**.
4. When prompted by the New Datastore Cluster wizard, perform the following actions.

Wizard Page	Action
General	In the **Datastore Cluster Name** field, type **`<Your_Name>DatastoreCluster`**, where <Your_Name> is your first name. Example: GregDatastoreCluster. Leave the **Turn on Storage DRS** check box selected. Click **Next**.
SDRS Automation	Leave the **No Automation (Manual Mode)** check box selected and click **Next**.
SDRS Runtime Rules	Leave the default settings and click **Next**
Select Hosts and Clusters	Select only the ESXi hosts in the datacenter. Click **Next**.
Select Datastores	In the **Show Datastores** field (upper-right corner), select **Show all datastores** from the drop-down menu. Select your Gold Tier and Silver Tier datastores. In a production environment, the best practice is to select datastores that are connected to all hosts in the cluster. Another best practice is to group datastores with similar storage capabilities. Click **Next**.
Ready to Complete	Click **Finish**.

5. Verify that the datastore cluster is displayed in the inventory and that it contains your Gold Tier and Silver Tier datastores.
6. Verify that your Gold Tier and Silver Tier datastores each contain a Windows virtual machine that is powered on. Select each datastore in the inventory and click the **Virtual Machines** tab.

Task 2: Perform a datastore evacuation with datastore maintenance mode

In this task, you will place a datastore in maintenance mode and apply a migration recommendation based on placing a datastore in maintenance mode. You will verify that the datastore is empty. Students should perform this task individually.

1. In the Datastores and Datastore Clusters inventory view, right-click your Silver Tier datastore and select **Enter SDRS Maintenance Mode**. The SDRS Maintenance Mode Migration Recommendations dialog box displays at least one recommendation and the reason for the recommendation.
2. Verify that the **Apply** check box is selected for all recommendations listed.
3. Click **Apply Recommendations**. View the **Recent Tasks** pane to monitor the progress of the migration.
4. After the migration is complete, verify that your Silver Tier datastore is in maintenance mode. The icon of a datastore in maintenance mode looks like this:

5. In the datastore's **Virtual Machines** tab, verify that no virtual machines are stored on your Silver Tier datastore.
6. Select the other datastore in the cluster (your Gold Tier datastore) and click the **Virtual Machines** tab. Verify that the virtual machines from the Silver Tier datastore are now on your Gold Tier datastore and that at least two virtual machines are powered on.
7. Right-click your Silver Tier datastore and select **Exit SDRS Maintenance Mode**. The datastore immediately exits maintenance mode. Because the automation level of your datastore cluster is set to **No Automation (Manual Mode)**, no VMware vSphere® Storage vMotion® migrations occur.

Task 3: Manually run Storage DRS and apply migration recommendations

In this task, you will manually run Storage DRS to generate a migration recommendation. You will apply the recommendation. Because Storage DRS automatically checks the use of disk space every five minutes, you will manually run Storage DRS instead of waiting for the migrations to occur automatically. Students should perform this task individually.

1. In the Datastores and Datastore Clusters view, select your datastore cluster in the inventory and click the **Storage DRS** tab. You might not see recommendations in the **Storage DRS Recommendations** panel.
2. If you do not see recommendations, click the **Run Storage DRS** link (in the upper-right corner) to generate recommendations based on the information that Storage DRS has collected. If no recommendations are displayed, the Storage DRS thresholds have not been met.
3. If no recommendations have been generated, decrease the utilized space threshold to generate at least one recommendation:
    a. In the **Datastore Cluster Properties** panel, click the **Edit** link. The Edit Datastore Cluster dialog box is displayed.
    b. In the left pane, select **SDRS Runtime Rules**. The **Utilized Space** field is set to the default: 80 percent.
    c. Move the slider all the way to the left to set **Utilized Space** to 50 percent.
    d. Click **OK**.
4. Click the **Run Storage DRS** link. At least one migration recommendation should be displayed in the **Storage DRS Recommendations** panel.
5. Verify that the **Apply** check box is selected for each recommendation**.**
6. Click **Apply Recommendations**. The recommendation should be removed. View the **Recent Tasks** pane to monitor the progress of the migration.
7. After the migration is complete, verify that your Gold Tier and Silver Tier datastores each contain at least one virtual machine.

Task 4: Acknowledge Storage DRS alarms

In this task, you will view a Storage DRS alarm and acknowledge it. Students should do the steps in this task individually.

1. In the Datastores and Datastore Clusters view, see whether your datastore cluster has an alert (indicated by a red diamond). If you do not see an alert, you did not receive Storage DRS recommendations.
2. If your datastore cluster has an alert, perform the following steps:
   a. Select your datastore cluster in the inventory and click the **Alarms** tab.
   b. In the **Triggered Alarms** pane, select the Storage DRS Recommendation alarm. This alarm is enabled by default. This alarm notifies you whenever Storage DRS makes a migration recommendation.
   c. Right-click the alarm and select **Acknowledge Alarm**. The alarm has been acknowledged.
   d. Right-click the alarm again and select **Clear**. The alarm is removed from the list, and the alert icon is removed from the datastore cluster inventory object.

Task 5: Clean up for the next lab

In this task, you will remove your datastore cluster in preparation for the next lab. Students should do the steps in this task individually.

1. Right-click your datastore cluster in the inventory and select **Remove**. Click **Yes** to verify removal.
2. Verify that the datastore cluster is removed from the inventory and that your Gold Tier and Silver Tier datastores are located directly under the Training datacenter.
3. Select **Home** > **Inventory** > **Hosts and Clusters**. Shut down both of your Windows virtual machines.

Leave the vSphere Client open.

Lab 10

Monitoring Storage Performance

Objective: Use performance charts to monitor disk performance

In this lab, you will perform the following tasks:

1. Identify the vmhbas used for local storage and shared storage.
2. Add disks to your test virtual machine.
3. Display the real-time disk performance charts of the vSphere Client.
4. Perform test case 1: Measure sequential write activity to your remote virtual disk.
5. Perform test case 2: Measure random write activity to your remote virtual disk.
6. Perform test case 3: Measure random read activity to your remote virtual disk.
7. Perform test case 4: Measure random read activity to your local virtual disk.
8. Summarize your findings.
9. Clean up for the next lab.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name	_____
Team vCenter Server Administrator password	_____
VMware vSphere® ESXi™ host name	_____
vmhba# of local storage (to be completed in task 1)	_____
vmhba# of shared storage (to be completed in task 1)	_____
Your test virtual machine name	_____
Root password for your test virtual machine	_____
Datastore on shared storage	_____

Task 1: Identify the vmhbas used for local storage and shared storage

In this task, you will identify the vmhba used for local storage and the vmhba used for shared storage. Students should perform this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your team vCenter Server system as user Administrator. Use the Administrator password recorded in "Preparing for the lab."
2. Select **Home** > **Inventory** > **Hosts and Clusters**.
3. Select your ESXi host in the inventory, whose name you recorded in "Preparing for the lab." Click the **Storage Views** tab.
4. Display the report called Show all SCSI Volumes (LUNs). Review the Runtime Name and Volume Name columns. From the information in these two columns, you can determine the vmhba# for the local storage and the vmhba# for the shared storage.

   Record this information in "Preparing for the lab."

Task 2: Add disks to your test virtual machine

In this task, you will add two virtual disks to your test virtual machine. The first virtual disk is on your local datastore, and the second virtual disk is on shared storage. Students should perform this task individually.

1. In the inventory, find your test virtual machine, whose name you recorded in "Preparing for the lab." Ensure that the test virtual machine is shut down.
2. Add a virtual disk to your test virtual machine, locating it on your local datastore:
   a. Right-click your test virtual machine and select **Edit Settings**. The virtual machine Properties dialog box is displayed.
   b. Click **Add.** The Add Hardware wizard appears.
   c. When prompted by the Add Hardware wizard, perform the following actions.

Wizard page	Action
Device Type	Select **Hard Disk** and click **Next**.
Select a Disk	Keep **Create a new virtual disk** selected and click **Next**.
Create a Disk	In the **Disk Size** field, type 8 GB. In the **Location** panel, keep the default if you know that your test virtual machine is located on the local datastore. If you are not sure, select **Specify a datastore or datastore cluster** and click **Browse**. Then, select your local datastore and click **OK**. Click **Next**.
Advanced Options	Leave the defaults and click **Next**.
Ready to Complete	Click **Finish**.

   d. Verify that a new entry for the hard disk appears in the **Hardware** pane with the word "(adding)" next to it. Do not click **OK** yet.

3. Add another virtual disk to your test virtual machine, this time locating it on your datastore on shared storage:

   a. Click **Add**. The Add Hardware wizard appears.

   b. When prompted by the Add Hardware wizard, perform the following actions.

Wizard page	Action
Device Type	Select **Hard Disk** and click **Next**.
Select a Disk	Keep **Create a new virtual disk** selected and click **Next**.
Create a Disk	In the **Disk Size** field, type 8 GB. For location, select **Specify a datastore or datastore cluster**. Browse to the datastore on shared storage, which you recorded in "Preparing for the lab" and click **OK**. Click **Next**.
Advanced Options	In the **Virtual Device Node** field, select **SCSI (1:0)** from the list and click **Next**.
Ready to Complete	Click **Finish**.

   c. Verify that entries for a new hard disk and a new SCSI controller appear in the **Hardware** pane with the word "(adding)" next to the entry.

   d. Click **OK** to add the virtual disks.

4. Power on your test virtual machine. Let the virtual machine boot up completely.

5. Open a console to your test virtual machine. Log in as root, using the root password that you recorded in "Preparing for the lab."

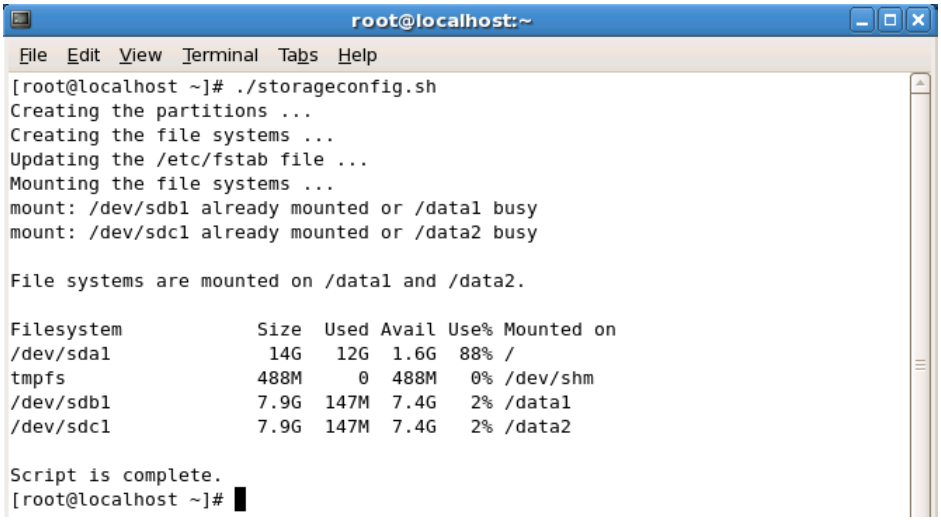
6. Create file systems on the virtual disks that you just added:

   a. In the test virtual machine's console, right-click the test virtual machine's desktop and select **Open Terminal**. Press Enter. The terminal window appears.

   b. Run the following script:

      ```
      # ./storageconfig.sh
      ```

      This script formats the virtual disks, creates a file system on each of the virtual disks, and mounts the file systems. The screenshot shows sample output.



Task 3: Display the real-time disk performance charts of the vSphere Client

In this task, you will display the real-time disk performance chart for your test virtual machine. Students should perform this task individually.

1. In the vSphere Client window, select your test virtual machine in the inventory.
2. Click the **Performance** tab.
3. Click the **Advanced** button.
4. Click the **Chart Options** link. The Customize Performance Chart dialog box is displayed.
5. Configure the Disk/Real-time performance chart settings as follows:
   a. In the **Chart Options** panel, expand **Disk** and select **Real-time**.
   b. In the **Objects** panel, ensure that only your test virtual machine is selected. Deselect all other objects.
   c. In the **Counters** panel, click **None**. Then, select the **Read Rate** and **Write Rate** check boxes.
   d. Click **OK**.
   e. Click the **Popup Chart** icon to display the current performance chart in a separate window.

Task 4: Perform test case 1: Measure sequential write activity to your remote virtual disk

In this task, you will generate and observe sequential write activity to the virtual disk on shared storage. Students should perform this task individually.

1. Generate sequential write activity to your virtual disk on shared storage:
   a. Go to the console of your test virtual machine.
   b. Change to the `aio-stress` directory. In the terminal window on the virtual machine's desktop, run the following command:

      ```
      $ cd aio-stress
      ```

   c. Start the `logwrite.sh` script. To do this, run the following command:

      ```
      $ ./logwrite.sh
      ```

      This script generates sequential writes to your virtual disk on shared storage. Let the script run and go to the next step.
2. Use the pop-up chart to observe sequential write activity:
   a. Go to your test virtual machine's pop-up chart.
   b. Observe the values found in the Latest column for Read rate and Write rate. Record the values in table 1 (at the end of this lab), in the Case 1: Sequential Writes to Remote Disk column.
3. Return to the console of your test virtual machine. Press Ctrl+C to end the `logwrite.sh` script.

Task 5: Perform test case 2: Measure random write activity to your remote virtual disk

In this task, you will generate and observe random write activity to the virtual disk on shared storage. Students should perform this task individually.

1. Generate random write activity to your virtual disk on shared storage. To do this, in the terminal window, run the following command:

   ```
   $ ./datawrite.sh
   ```

   This script generates random writes to your virtual disk on shared storage. Let the script run.
2. Use the pop-up chart to observe random write activity:
   a. Go to your test virtual machine's pop-up chart.
   b. Observe the values found in the Latest column for Read rate and Write rate. Record the values in table 1 (at the end of this lab), in the Case 2: Random Writes to Remote Disk column.
3. Return to the console of your test virtual machine. Press Ctrl+C to end the `datawrite.sh` script.

Task 6: Perform test case 3: Measure random read activity to your remote virtual disk

In this task, you will generate and observe random read activity to the virtual disk on shared storage. Students should perform this task individually.

1. Generate random read activity to your virtual disk on shared storage. To do this, run the following command:

   ```
   $ ./fileserver2.sh
   ```

   This script generates random reads to your virtual disk on shared storage. Let the script run.

2. Use the pop-up chart to observe random read activity:

   a. Go to your test virtual machine's pop-up chart.

   b. Observe the values found in the Latest column for Read rate and Write rate. Record the values in table 1 (at the end of this lab), in the Case 3: Random Reads to Remote Disk column.

3. Return to the console of your test virtual machine. Press Ctrl+C to end the `fileserver2.sh` script.

Task 7: Perform test case 4: Measure random read activity to your local virtual disk

In this task, you will generate and observe random read activity to the local virtual disk. Students should perform this task individually.

1. Generate random read activity to your local virtual disk:

   a. Start the `fileserver1.sh` script. To do this, run the following command:

   ```
   $ ./fileserver1.sh
   ```

   This script first stages a write, which can take up to 5 minutes. Then the script generates random reads to your virtual disk on the local datastore. Let the script run. After the initial write, you will see a continuous sequence of random reads.

2. Use the pop-up chart to observe random read activity:

   a. Go to your test virtual machine's pop-up chart.

   b. Observe the values found in the Latest column for Read rate and Write rate. Record the values in table 1 (at the end of this lab), in the Case 4: Random Reads to Local Disk column.

3. Return to the console of your test virtual machine. The `fileserver1.sh` script should have finished. If it has not finished, press Ctrl+C to end the script.

Task 8: Summarize your findings

In this task, you will summarize your findings. Students should perform this task individually.

View the table at the end of this lab. What conclusions can you draw from the data that you recorded? Your instructor will review the results with you.

Task 9: Clean up for the next lab

In this task, you will clean up your desktop. Students should perform this task individually.

1. Close the test virtual machine's pop-up chart.
2. In the console of your test virtual machine, leave the terminal window open.
3. Leave your test virtual machine console open.
4. Leave the vSphere Client open.

Table 1: vSphere Client Counters: Disk Read Rate and Disk Write Rate

vSphere Client Counters	Case 1: Sequential writes to remote disk	Case 2: Random writes to remote disk	Case 3: Random reads to remote disk	Case 4: Random reads to local disk
Read Rate				
Write Rate				

Lab 11

Command-Line Storage Management

Objective: Use various commands to view storage information and monitor storage activity

In this lab, you will perform the following tasks:

1. Use esxcli to view storage configuration information.
2. Use vmkfstools to manage volumes and virtual disks.
3. Generate disk activity in your test virtual machine.
4. Start vscsiStats.
5. Use vscsiStats to generate a histogram for disk latency.
6. Use vscsiStats to determine type of I/O disk activity.
7. Generate disk activity in your test virtual machine.
8. Use vscsiStats to determine type of I/O disk activity.
9. Clean up for the next lab.

Preparing for the lab

Record the following information:

VMware vSphere® Management Assistant (vMA) system name _____

vMA vi-admin password _____

VMware vSphere® ESXi™ host name	_____
ESXi host root password	_____
Local datastore name	_____
Team VMware® vCenter Server™ system name	_____
Team vCenter Server Administrator password	_____
Test virtual machine name	_____
Root password for test virtual machine	_____

Task 1: Use esxcli to view storage configuration information

In this task, you will use the vMA command line to list information about your storage configuration. Students should do the steps in this task individually.

NOTE

If you have logged out of your vMA session, start PuTTY again. Log in to vMA by using the vMA information that you recorded in "Preparing for the lab."

1. Verify that your vMA fastpass target is still set:
   a. Display your current fastpass target setting:

      ```
      vifp listservers
      ```

   b. If your ESXi host is not set as a target, then set the fastpass target to your ESXi host:

      ```
      vifptarget -s <your_ESXi_host>
      ```

      Replace <your_ESXi_host> with the ESXi host name that you recorded in "Preparing for the lab."
2. List all SCSI host bus adapters on the system:

   ```
   esxcli storage core adapter list
   ```
3. Retrieve the statistics for all of the vmhba adapters:

   ```
   esxcli storage core adapter stats get
   ```
4. List the available storage partitions visible to your ESXi host:

   ```
   esxcli storage core device partition list
   ```
5. List the path to the storage devices:

   ```
   esxcli storage core path list
   ```

Task 2: Use vmkfstools to manage volumes and virtual disks

In this task, you will use the vmkfstools command to manage virtual machine disk files. Students should do the steps in this task individually.

1. Print the vmkfstools help.

   vmkfstools --help

2. List the attributes of the local datastore whose name you recorded in "Preparing for the lab."

   vmkfstools -P [<local_datastore_name>]

   For example, if the datastore name is Local01, then enter the following command line:

   vmkfstools -P [Local01]

3. Create a thin provisioned virtual disk named test01.vmdk that is 10MB in size and is located on the local datastore named test01.

   vmkfstools -c 10m -d thin '[<local_datastore_name>] test01.vmdk'

   For example, if the datastore name is Local01, then enter the following command line:

   vmkfstools -c 10m -d thin '[Local01] test01.vmdk'

4. Rename the virtual disk to test-<your_initials>.vmdk.

   vmkfstools -E '[<local_datastore_name>] test01.vmdk' '[<local_datastore_name>] test-<your_initials>.vmdk'

   For example, if the datastore name is Local01 and your initials are CG, then enter the following command line:

   vmkfstools -E'[Local01] test01.vmdk' '[Local01] test-CG.vmdk'

5. Convert the virtual disk from a thin provisioned to an eagerzeroedthick virtual disk.

   vmkfstools -j '[<local_datastore_name>] test-<your_initials>.vmdk'

6. Display the virtual disk geometry.

   vmkfstools -g '[<local_datastore_name>] test-<your_initials>.vmdk'

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

   vmkfstools -X 20m -d eagerzeroedthick '[<local_datastore_name>] test-<your_initials>.vmdk'

8. Display the virtual disk geometry and compare the difference with the output from the command that you ran in step 6.

   vmkfstools -g '[<local_datastore_name>] test-<your_initials>.vmdk'

9. Remove the virtual disk.

   vmkfstools -U '[<local_datastore_name>] test-<your_initials>.vmdk'

   Leave your vMA session open.

Task 3: Generate disk activity in your test virtual machine

In this task, you will run the `datawrite.sh` script to generate disk activity in your test virtual machine. Students should perform this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your team vCenter Server system as user Administrator. Use the Administrator password recorded in "Preparing for the lab."
2. Verify that the console to your test virtual machine is open. You recorded your test virtual machine name in "Preparing for the lab." You should be logged in as root, and a terminal window should be open on its desktop.
3. In the terminal window on your test virtual machine's desktop, generate disk activity to your virtual disk on shared storage:
   a. Verify that you are in the `aio-stress` directory. If you are not, then run the following command:

      ```
      # cd ~/aio-stress
      ```

   b. Start the `datawrite.sh` script. To do this, run the following command:

      ```
      # ./datawrite.sh
      ```

      Leave your test virtual machine's console and the vSphere Client window open.

Task 4: Start vscsiStats

In this task, you will use `vscsiStats` to start capturing disk data for your test virtual machine. Students should perform this task individually.

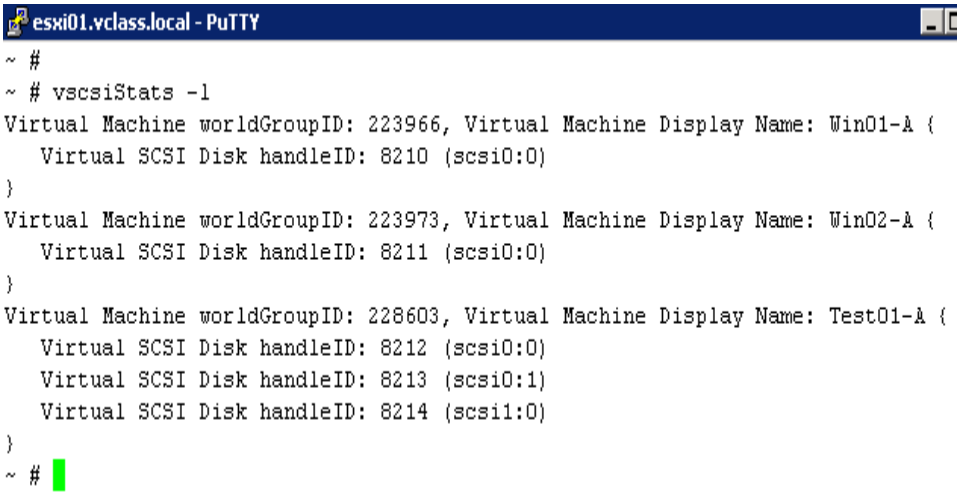
1. From your vCenter Server desktop, open a PuTTY session to your ESXi host. Log in as root, using the password that you recorded in "Preparing for the lab."
2. Use the `vscsiStats` command to generate a list of the running virtual machines on your ESXi host:

   ```
   # vscsiStats -l
   ```

   NOTE

   The command is case-sensitive.

The screenshot shows an example of the command's output.



3. Record the value of worldGroupID for your test virtual machine: _____

4. Capture data for your test virtual machine. To do this, run the following command:

   # **vscsiStats -s -w <worldGroupID>**

   where <worldGroupID> is the value that you recorded above.

   Although `vscsiStats` exits, it is still gathering data. Allow `vscsiStats` to gather data for about two minutes before you go to the next step.

Task 5: Use vscsiStats to generate a histogram for disk latency

In this task, you will use `vscsiStats` to display the histogram data set for disk latency. Students should perform this task individually.

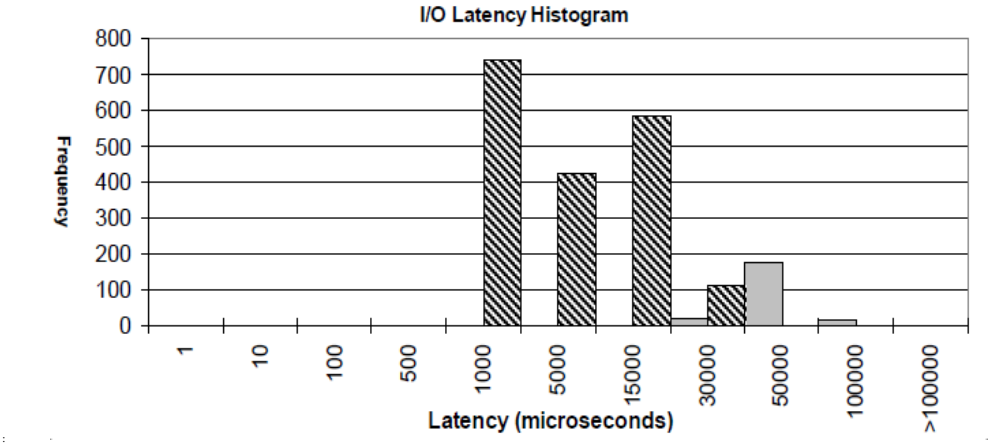
1. Run `vscsiStats` with the `-p latency` option:

   ```
   # vscsiStats -p latency
   ```

   NOTE

   This command generates more data than will fit on one screen. For the purposes of this lab, you are interested only in the last set of data. To see all of the data generated, use the modifier > (right angle bracket) to send the command's output to a text file. Example: `vscsiStats -p latency > <output_file>`, where <output_file> is the name of a file.

2. Using the data from the `-p` output, sketch a histogram for your disk's Write I/O Latency. The graphic shows an example.



3. Run the command again, but this time, include the `-c` option in the command line:

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

   How is the command's output different when the `-c` option is used?

Task 6: Use vscsiStats to determine type of I/O disk activity

In this task, you will use `vscsiStats` to display the histogram data set for seek distance to determine if the virtual machine is generating random or sequential I/O traffic. Students should perform this task individually.

1. Run `vscsiStats` using the `-p seekDistance` option:

   ```
   # vscsiStats -p seekDistance
   ```

2. Using the data from the output, sketch a histogram for the distance between successive write commands for your virtual machine.

   Based on the information you gathered, is the script generating random or sequential writes?

3. Stop the `vscsiStats` data collection, but leave all of the windows open:

   ```
   # vscsiStats -x
   ```

Task 7: Generate disk activity in your test virtual machine

In this task, you will run the `logwrite.sh` script to generate sequential disk activity in your test virtual machine. Students should perform this task individually.

1. Return to the console of your test virtual machine.
2. In the window running `datawrite.sh`, press Ctrl+C to stop the script.
3. Generate sequential disk activity to your virtual disk on shared storage:

   Start the `logwrite.sh` script. To do this, run the following command:

   ```
   $ ./logwrite.sh
   ```

   Leave the virtual machine's console and the vSphere Client open.

Task 8: Use vscsiStats to determine type of I/O disk activity

In this task, you will use `vscsiStats` to display the histogram data set for seek distance to determine whether the virtual machine is generating random or sequential I/O traffic. Students should perform this task individually.

1. Return to the PuTTY session to your ESXi host.
2. Verify that the worldGroupID for your test virtual machine has not changed:

   # **`vscsiStats -l`**

3. Record the value of worldGroupID for your test virtual machine: _____
4. Capture data for your virtual machine. To do this, run the following command:

   # **`vscsiStats -s -w <worldGroupID>`**

   where <worldGroupID> is the value that you recorded above.

   Allow `vscsiStats` to gather data for about two minutes before you go to the next step.

5. Run `vscsiStats` with the `-p seekDistance` option:

   # **`vscsiStats -p seekDistance`**

6. Using the data from `-p` output, sketch a histogram for the distance between successive write commands for your virtual machine.
7. Based on the information you gathered, is the script generating random or sequential writes?

8. Stop the `vscsiStats` data collection.

   # **`vscsiStats -x`**

Task 9: Clean up for the next lab

In this task, you will prepare your desktop for the next lab. Students should perform this task individually.

1. Exit the PuTTY session to your ESXi host. To do this, type **`exit`** at the command prompt.
2. Return to the console of your test virtual machine. In the window running `logwrite.sh`, press Ctrl+C to stop the script.
3. Leave the terminal window and the console to your test virtual machine open.
4. Leave the vSphere Client open.

Lab 12

Monitoring CPU Performance

Objective: Use performance charts and resxtop to monitor CPU performance

In this lab, you will perform the following tasks:

1. Run a single-threaded program in a single-vCPU virtual machine.
2. Use esxtop to observe baseline data.
3. Use the vSphere Client to observe baseline data.
4. Import the CPU-HOG vApp.
5. Generate CPU contention.
6. Observe the performance of the test virtual machine.
7. Run a single-threaded program in a dual-vCPU virtual machine.
8. Observe the performance of the test virtual machine.
9. Run a dual-threaded program in a dual-vCPU virtual machine.
10. Observe the performance of the test virtual machine.
11. Run a multithreaded program in a quad-vCPU virtual machine.
12. Observe the performance of the test virtual machine.
13. Summarize your findings.
14. Clean up for the next lab.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name	_____
Team vCenter Server Administrator password	_____
Your test virtual machine name	_____
Root password for the test virtual machine	_____
VMware vSphere® Management Assistant (vMA) system name	_____
vMA vi-admin password	_____
VMware vSphere® ESXi™ host name	_____
OVF pathname	_____
Your local datastore	_____

Task 1: Run a single-threaded program in a single-vCPU virtual machine

In this task, you will run a single-threaded program in a single-vCPU virtual machine. Students should perform this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your vCenter Server system as user Administrator. Use the Administrator password recorded in "Preparing for the lab."
2. Select **Home** > **Inventory** > **Hosts and Clusters**.
3. In the inventory, find your test virtual machine, whose name you recorded in "Preparing for the lab."
4. Verify that your test virtual machine is configured with one virtual CPU (vCPU). To do this, select your test virtual machine in the inventory and click the **Summary** tab. In the **General** panel, verify that the number of vCPUs is 1.

   Your test virtual machine should be powered on, you should be logged in as root, and a terminal window should be open on the desktop.

5. In the terminal window change to the root user's home directory:

   # **cd ~**

6. Run the following command to start database activity:

   # **./starttest1**

   This script generates database operations to a medium-sized database and writes output to the screen. Allow the script to run continuously.

Task 2: Use esxtop to observe baseline data

In this task, you will use the `esxtop` command to observe and record baseline performance values for your test virtual machine. Students should perform this task individually.

1. Go to your ESXi host PuTTY window. If the window is closed, use the following steps to reconnect to your vMA:
   a. Start a PuTTY session and connect to the ESXi host whose name you recorded in "Preparing for the lab."
   b. Log in as root, using the root password recorded in "Preparing for the lab."
2. Verify that `esxtop` is running. If it is not running, start it by typing the following command line:

   resxtop

3. Verify that the CPU screen is displayed. If it is not, type **c**.
4. If necessary, stretch the `esxtop` window horizontally so that you can see all the columns.
5. Change the delay between updates from the default (5 seconds) to 20 seconds. Type **s**, type **20**, and then press Return.
6. Type **V** (uppercase V) to display just the virtual machine groups. Find your test virtual machine in the screen.
7. Observe the baseline performance of your test virtual machine and record the values for %USED, %SYS, and %RDY in table 1 at the end of this lab. Record your values in the Baseline Data column.

Task 3: Use the vSphere Client to observe baseline data

In this task, you will use the vSphere Client to observe and record baseline performance values for your test virtual machine. Students should perform this task individually.

1. Go to your vSphere Client window. Select your test virtual machine in the inventory and click the **Performance** tab. Click **Advanced**. The most recently accessed performance chart is displayed.
2. Click the **Chart Options** link. The Customize Performance Chart dialog box is displayed.
3. Change the current chart settings as follows:
   a. In the **Chart Options** panel, expand **CPU** and select **Real-time**.
   b. In the **Objects** panel, ensure that only your test virtual machine is selected. Deselect all other objects.
   c. In the **Counters** panel, click **None** to deselect all the counters. Select the **Ready** and **Usage** check boxes.
   d. Click **OK**.
4. Display the current performance chart in a separate window. To do this, click the **Popup Chart** icon in the upper-right corner of the **Performance** tab.
5. Observe the baseline performance of your test virtual machine and record the values for Ready and Usage in table 2 at the end of this lab. Record your values in the Baseline Data column.

Task 4: Import the CPU-HOG vApp

In this task, you will import a vApp named CPU-HOG. CPU-HOG will help generate CPU contention for your test virtual machine. Students should perform this task individually.

1. In the vSphere Client menu bar, select **File** > **Deploy OVF Template**.
2. When prompted by the Deploy OVF Template wizard, perform the following actions.

Wizard Page	Action
Source	In the **Deploy from a file or URL** field, click **Browse**. Browse to the OVF pathname that you recorded in "Preparing for the lab." Click **Next**.
OVF Template Details	Click **Next**.

Wizard Page	Action
Name and Location	In the **Name** field, type **`CPU-HOG##`**, where ## is the number of your ESXi host, for example, CPU-HOG01. In the **Inventory Location** pane, select the Training datacenter.
Host / Cluster	Select your ESXi host in the inventory and click **Next**.
Storage	Select your local datastore, whose name you recorded in "Preparing for the lab." Click **Next**.
Disk Format	Leave the defaults and click **Next**.
Ready to Complete	Click **Finish**.

3. Monitor the OVF deployment progress. Verify that the deployment completes successfully.

   CPU-HOG is a vApp located in the inventory under your ESXi host. A number is appended to the name CPU-HOG, which corresponds to the number of your ESXi host. CPU-HOG contains 10 virtual machines, Workload01 through Workload10. The letter "a" or "b" is appended to the end of each name. Except for their names, these virtual machines are identical.

   Leave the CPU-HOG vApp powered off for now.

Task 5: Generate CPU contention

In this task, you will generate CPU contention for your test virtual machine. Students should perform this task individually.

1. Limit the CPU resources available to your CPU-HOG vApp:
   a. Right-click CPU-HOG and select **Edit Settings**. The Edit vApp Settings dialog box is displayed.
   b. In the **CPU Resources** pane, deselect the **Expandable Reservation** check box.
   c. Deselect the **Unlimited** check box.
   d. Set **Limit** to 5,000MHz.
   e. Click **OK**.
2. Power on CPU-HOG. To do this, right-click CPU-HOG and select **Power On**.

3. Monitor the progress of the task in the **Recent Tasks** pane. While the virtual machines are powering on, open a console to each of the 10 virtual machines.
4. In the console of the Workload01 virtual machine, generate CPU activity by starting a CPU test called CPU Burn-in V1.00:
   a. Click anywhere in the virtual machine console to change the mouse focus.
   b. At the boot prompt, press Enter. The virtual machine will continue to display the boot prompt (boot:) until you press Enter. When you press Enter, the Ultimate Boot CD V4.1.1 main menu appears.
   c. Press Enter to select Mainboard Tools.
   d. Using the down arrow key, select CPU Tests, then press Enter.
   e. Using the down arrow key, select CPU Burn-in V1.00, then press Enter. The CPU test will start, which will generate CPU activity.
   f. Press Ctrl+Alt to release mouse focus.
   g. Close the virtual machine's console. The CPU test continues to run even if you close the console of the virtual machine.
   h. Using the same steps, start the CPU test in each of the remaining workload virtual machines, Workload02 through Workload10.

      The sole purpose of the CPU-HOG vApp is to create CPU contention for your test virtual machine.

Task 6: Observe the performance of the test virtual machine

In this task, you will observe and measure the performance of your test virtual machine after creating CPU contention. Students should perform this task individually.

1. Go to the real-time CPU pop-up chart. Record the latest values for Ready and Usage in table 2, at the end of this lab. Record your values in the Case 1: 1 Thread, 1 vCPU column.
2. Return to your `esxtop` window. Allow the screen to update at least once, then for your test virtual machine, record the values of %USED, %SYS, and %RDY in table 1 at the end of this lab. Record your values in the Case 1: 1 Thread, 1 vCPU column.
3. Return to the console of your test virtual machine. View the output of the `starttest1` script and look for the counters named opm (operations per minute) and rt_tot_avg_msec (round-trip total average in milliseconds). Record their values in table 3 at the end of this lab. Record your values in the Case 1: 1 Thread, 1 vCPU column.
4. Stop the `starttest1` script by pressing Ctrl+C in the terminal window.

Task 7: Run a single-threaded program in a dual-vCPU virtual machine

In this task, you will run a single-threaded process in a dual-vCPU virtual machine. Students should perform this task individually.

1. Return to the vSphere Client window. Shut down your test virtual machine. Wait for the virtual machine to power off before continuing to the next step.
2. Modify your test virtual machine to have two vCPUs:
   a. Right-click your test virtual machine and select **Edit Settings**.
   b. In the **Hardware** panel, select CPUs in the hardware list and change **Number of virtual sockets** to 2. Ensure **Number of cores per socket** is set to 1. Click **OK**.
3. Power on your test virtual machine.
4. While your test virtual machine is powering on, go to the console of your test virtual machine. Wait for the virtual machine to finish booting.
5. At the login prompt, log in as root, using the root password that you recorded in "Preparing for the lab."
6. From your test virtual machine's desktop, open a terminal window.
7. In the terminal window, run the following command to start database activity:

   ```
   # ./starttest1
   ```

   The script writes output to the screen. Allow the script to run continuously.

Task 8: Observe the performance of the test virtual machine

In this task, you will observe the performance of your test virtual machine, which is configured with two vCPUs and is running a single-threaded process. Students should perform this task individually.

1. Return to your `esxtop` window. Allow the screen to update at least once. Then for your test virtual machine, record the values of %USED, %SYS, and %RDY in table 1 at the end of this lab. Record your values in the Case 2: 1 Thread, 2 vCPUs column.
2. Return to the real-time CPU pop-up chart. Record the latest values for Ready and Usage in table 2 at the end of this lab. Record your values in the Case 2: 1 Thread, 2 vCPUs column.
3. Return to the console of your test virtual machine. View the output of the `starttest1` script and look for the counters named opm (operations per minute) and rt_tot_avg_msec (round-trip total average). Record their values in table 3 at the end of this lab. Record your values in the Case 2: 1 Thread, 2 vCPUs column.
4. Stop the `starttest1` script by pressing Ctrl+C in the terminal window.

Task 9: Run a dual-threaded program in a dual-vCPU virtual machine

In this task, you will run a dual-threaded process in a dual-vCPU test virtual machine. Students should perform this task individually.

In the terminal window of your test virtual machine, run the following command to generate database activity:

```
# ./starttest2
```

This script generates database operations to a medium-sized database. The number of threads is set to 2. Allow the script to run continuously.

Task 10: Observe the performance of the test virtual machine

In this task, you will observe the performance of your test virtual machine, which is configured with two vCPUs and is running a dual-threaded process. Students should perform this task individually.

1. Return to your `esxtop` window. Allow the screen to update at least once. Then for your test virtual machine, record the values of %USED, %SYS, and %RDY in table 1 at the end of this lab. Record your values in the Case 3: 2 Threads, 2 vCPUs column.
2. Return to the real-time CPU pop-up chart. Record the latest values for Ready and Usage in table 2 at the end of this lab. Record your values in the Case 3: 2 Threads, 2 vCPUs column.
3. Return to the console of your test virtual machine. View the output of the `starttest2` script and look for the counters named opm (operations per minute) and rt_tot_avg_msec (round-trip total average). Record their values in table 3 at the end of this lab. Record your values in the Case 3: 2 Threads, 2 vCPUs column.
4. Stop the `starttest2` script by pressing Ctrl+C in the terminal window.

Task 11: Run a multithreaded program in a quad-vCPU virtual machine

In this task, you will run a multithreaded process in a quad-vCPU test virtual machine. Students should perform this task individually.

1. Return to the vSphere Client window. Shut down your test virtual machine. Wait for the virtual machine to power off before continuing to the next step.
2. Modify your test virtual machine to have four vCPUs:
   a. Right-click your test virtual machine and select **Edit Settings**.
   b. In the **Hardware** panel, select CPUs in the hardware list and change **Number of virtual sockets** to 4. Ensure **Number of cores per socket** is set to 1. Click **OK**.
3. Power on your test virtual machine.
4. While your test virtual machine is powering on, open a console to your test virtual machine. Wait for the virtual machine to finish booting.

5. At the login prompt, log in as root, using the root password that you recorded in “Preparing for the lab.”
6. Open a terminal window.
7. In the terminal window, run the following command to start multithreaded database activity:

   ```
   # ./starttest4
   ```

   This script generates database operations to a medium-sized database. The number of threads is set to 4. Allow the script to run continuously.

Task 12: Observe the performance of the test virtual machine

In this task, you will observe the performance of your test virtual machine, which is configured with four vCPUs and is running a multithreaded process. Students should perform this task individually.

1. Return to your `esxtop` window. Allow the screen to update at least once, then for your test virtual machine, record the values of %USED, %SYS, and %RDY in table 1 at the end of this lab. Record your values in the Case 4: 4 Threads, 4 vCPUs column.
2. Return to the real-time CPU pop-up chart. Record the latest values for Ready and Usage in table 2 at the end of this lab. Record your values in the Case 4: 4 Threads, 4 vCPUs column.
3. Return to the console of your test virtual machine. View the output of the `starttest4` script and look for the counters named opm (operations per minute) and rt_tot_avg_msec (round-trip total average). Record their values in table 3 at the end of this lab. Record your values in the Case 4: 4 Threads, 4 vCPUs column.
4. Stop the `starttest4` script by pressing Ctrl+C in the terminal window.

Task 13: Summarize your findings

In this task, you will summarize your findings. Students should perform this task individually.

View the tables at the end of this lab. What conclusions can you draw from the data that you recorded? Your instructor will review the results with you.

Task 14: Clean up for the next lab

In this task, you will prepare your desktop for the next lab. Students should perform this task individually.

1. Keep the CPU real-time pop-up chart open.
2. Leave CPU-HOG running. You will use it in the next lab.
3. Leave your test virtual machine powered on
4. Leave the console to your test virtual machine open.
5. Leave the vMA window open.
6. Leave the ESXi host PuTTY session open.
7. Leave the vSphere Client window open.

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

resxtop counter	Baseline data	Case 1: 1 thread, 1 vCPU	Case 2: 1 thread, 2 vCPUs	Case 3: 2 threads, 2 vCPUs	Case 4: 4 threads, 4 vCPUs
%USED					
%SYS					
%RDY					

Table 2: vSphere Client: CPU Usage and CPU Ready

vSphere Client counter	Baseline data	Case 1: 1 thread, 1 vCPU	Case 2: 1 thread, 2 vCPUs	Case 3: 2 threads, 2 vCPUs	Case 4: 4 threads, 4 vCPUs
CPU Usage					
CPU Ready					

Table 3: Test Program Counters: opm and rt_tot_avg_msec

Test VM counters	Case 1: 1 thread, 1 vCPU	Case 2: 1 thread, 2 vCPUs	Case 3: 2 threads, 2 vCPUs	Case 4: 4 threads, 4 vCPUs
opm				
rt_tot_avg_msec				

Lab 13

Diagnosing CPU Performance

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

In this lab, you will perform the following tasks:

1. Generate CPU activity.
2. Display pop-up charts for your ESXi host and your test virtual machine.
3. Check for host CPU saturation.
4. Check for guest CPU saturation.
5. Check for using only one vCPU in an SMP virtual machine.
6. Check for low guest CPU utilization.
7. Summarize your findings.
8. Clean up for the next lab.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name _____

Team vCenter Server Administrator password _____

VMware vSphere® ESXi™ host name _____

ESXi host root password _____

Your test virtual machine name _____

Root password for the test virtual machine _____

Task 1: Generate CPU activity

In this task, you will generate database activity. Students should perform this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your team vCenter Server system as user Administrator. Use the Administrator password recorded in "Preparing for the lab."
2. Go to the console of your test virtual machine, whose name you recorded in "Preparing for the lab." You should be logged in with a terminal window open.
3. Restart the `starttest4` script:

   ```
   $ ./starttest4
   ```

4. In the vSphere Client window, drag your test virtual machine into your CPU-HOG vApp. If a Resource Settings warning appears, click **Yes**.

Task 2: Display pop-up charts for your ESXi host and your test virtual machine

In this task, you will use the vSphere Client to display a CPU performance chart for your ESXi host. You will also modify the current CPU performance chart for your test virtual machine. Students should perform this task individually.

1. Display the real-time CPU performance chart for CPU usage on your ESXi host:
   a. Select your ESXi host in the inventory and click the **Performance** tab. Click **Advanced**.
   b. Click the **Chart Options** link. The Customize Performance Chart dialog box is displayed.
   c. In the **Chart Options** panel, expand **CPU** and select **Real-time**.
   d. In the **Chart Type** panel, select **Line graph**.

e. In the **Objects** panel, ensure that only your ESXi host is selected. Deselect all other objects.

f. In the **Counters** panel, ensure that only the **Usage** check box is selected. Deselect all other counters.

g. Click **OK**.

h. Click the **Popup Chart** icon in the upper-right corner of the **Performance** tab.

2. Modify your test virtual machine's performance chart:

a. In the inventory, select your test virtual machine and select the **Performance** tab. Click the **Chart Options** link. The Customize Performance Chart dialog box is displayed.

b. In the **Chart Options** panel, expand **CPU** and select **Real-time**.

c. In the **Chart Type** panel, select **Line graph**.

d. In the **Objects** panel, modify it so that all the virtual CPUs are selected as well as your test virtual machine.

e. In the **Counters** panel, ensure that only the **Ready** and **Usage in MHz** check boxes are selected. Deselect all other counters.

f. Click **OK**.

g. Click the **Popup Chart** icon in the upper-right corner of the **Performance** tab.

Task 3: Check for host CPU saturation

In this task, you will use the vSphere Client and `esxtop` to check to see whether the CPUs on your ESXi host are saturated. Students should perform this task individually.

1. Check for high CPU usage on your ESXi host:

a. In your ESXi host's pop-up chart, view the average value and maximum (peak) value for Usage. Record the values here: _____

b. Go to your `esxtop` window. On the PCPU UTIL (%) line, near the top of the screen, check the AVG value. Record the value here: _____

Review the pop-up chart. Is the average CPU usage > 75 percent or are the peaks > 90 percent? _____

If the answer to either condition is yes, the host's CPUs might be saturated.

If the answer to either condition is no, then host CPU saturation is not present.

2. Check for high ready time on your test virtual machine:

   a. Go to your test virtual machine's pop-up chart. View the latest value for Ready for each of the vCPUs. Record the values here: _____

   b. Go to your VMware vSphere® Management Assistant (vMA) window where `esxtop` is running. Expand your test virtual machine so that you see its individual worlds. To do this, type **e**.

   c. Enter the GID of your test virtual machine. Press Enter. Check the %RDY values for each of the vCPU worlds belonging to your test virtual machine. Record the values here:

      _____

      Review the pop-up chart data for your test virtual machine. Is ready time greater than 2,000 milliseconds for any vCPU object? (Or you can review your `esxtop` data and check whether ready time for any vCPU world is > 10 percent.) _____

      If the answer is yes, host CPU saturation exists.

      If the answer is no, host CPU saturation is not present.

   d. In the `esxtop` window, roll up (hide) your virtual machine worlds. To do this, type **e**. Enter the GID of your test virtual machine. Press Enter.

Task 4: Check for guest CPU saturation

In this task, you will use the vSphere Client and `esxtop` to check to see whether the CPU resources of your test virtual machine are saturated. Students should perform this task individually.

1. Check the CPU usage of your test virtual machine:

   a. Go to your test virtual machine's pop-up chart. View the average value and maximum (peak) value for **Usage in MHz**. Record the values here:

      _____

   b. Go to the `esxtop` window and check the %USED value for your test virtual machine. Record the value here: _____

      Review the pop-up chart data of your test virtual machine. Is CPU usage > 75 percent or are the peaks > 90 percent? _____

      If the answer to either condition is yes, guest CPU saturation exists.

      If the answer to either condition is no, guest CPU saturation is not present.

Task 5: Check for using only one vCPU in an SMP virtual machine

In this task, you will use the vSphere Client and `esxtop` to check to see whether your four-vCPU virtual machine is using only one vCPU. Students should perform this task individually.

1. Check the CPU usage of your test virtual machine:
   a. Go to your test virtual machine's pop-up chart. View the average value and maximum (peak) value for **Usage in MHz** for each of its vCPUs.
   b. In the `esxtop` window, check the %USED values for each of the vCPUs in your test virtual machine. (Type **e** to expand your test virtual machine.)

      Is the usage for all vCPUs except one close to 0? _____

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

      If the answer is no, the SMP virtual machine is using all its vCPUs.
   c. In the `esxtop` window, roll up (hide) your virtual machine worlds. To do this, type **e**. Enter the GID of your test virtual machine. Press Enter.

Task 6: Check for low guest CPU utilization

In this task, you will use the vSphere Client and `esxtop` to check to see whether CPU utilization on your test virtual machine is low. Students should perform this task individually.

1. Check the CPU usage of your test virtual machine:
   a. Go to your test virtual machine's pop-up chart. View the average value for **Usage in MHz** for your test virtual machine. Record the value here: _____
   b. In the `esxtop` window, check the %USED value for your test virtual machine. Record the value here: _____

      Is the average value < 75 percent? _____

      If the answer is yes, virtual machine CPU utilization is low. This use 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 this time.)

      If the answer is no, virtual machine CPU saturation is not present.

Task 7: Summarize your findings

In this task, you will summarize your findings. Students should perform this task individually.

1. Answer the following questions:
   a. Is there a CPU problem on the ESXi host?
   b. If a CPU problem exists, is it affecting your test virtual machine?
2. Explain your answer.

Task 8: Clean up for the next lab

In this task, you will clean up your desktop in preparation for the next lab. Students should perform this task individually.

1. Go to the console of your test virtual machine. In the terminal window, press Ctrl+C to end the `starttest4` script.

   Leave the console to your test virtual machine open.
2. In the inventory, drag your test virtual machine from your CPU-HOG vApp to your ESXi host.
3. Power off your CPU-HOG vApp (right-click the vApp and select **Power Off**).
4. Remove your CPU-HOG vApp from the inventory. Right-click the CPU-HOG vApp and select **Remove from Inventory**. Click **Yes** to confirm the removal from the inventory of the vApp and the virtual machines in it.
5. Close the pop up chart windows for your ESXi host and your test virtual machine.
6. Leave the vSphere Client open.
7. Leave the `esxtop` window open.
8. Leave `esxtop` running.

Lab 14

Monitoring Memory Performance

Objective: Use performance charts and resxtop to monitor memory performance

In this lab, you will perform the following tasks:

1. Generate database activity.
2. Display the memory screen in resxtop.
3. Display a memory performance chart for your test virtual machine.
4. Observe your test virtual machine's memory usage.
5. Import the RAM-HOG vApp.
6. Overcommit memory resources.
7. Observe memory statistics.
8. Clean up for the next lab.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name	_____
Team vCenter Server Administrator password	_____
Your test virtual machine name	_____
Root password for the test virtual machine	_____
VMware vSphere™ Management Assistant (vMA) system name	_____
vMA vi-admin password	_____
VMware vSphere® ESXi™ host name	_____
OVF pathname	_____
Your local datastore	_____

Task 1: Generate database activity

In this task, you will generate database activity. Students should perform this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your team vCenter Server system as user Administrator. Use the Administrator password recorded in "Preparing for the lab."
2. Go to the console of your test virtual machine. You recorded the name of your test virtual machine in "Preparing for the lab." You should be logged in with a terminal window open on virtual machine's desktop.
3. Generate database activity. To do this, at the command prompt, run the following command:

   ```
   $ ./starttest4
   ```

   This script generates database operations to a medium-sized database. It has been configured to run indefinitely. Let the script run continuously.

Task 2: Display the memory screen in resxtop

In this task, you will run `esxtop` and you will display the memory screen. Students should perform this task individually

1. Go to your PuTTY session where `esxtop` is running. If you must reopen the `esxtop` window, use the following steps:
   a. Start a PuTTY session and connect to the ESXi host, whose name you recorded in "Preparing for the lab."
   b. Log in as root, using the root password recorded in "Preparing for the lab."
   c. Run the following `esxtop` command. Type the entire command on a single line:

      ```
      $ esxtop
      ```
2. Type **`m`** to display the memory screen.
3. Type **`V`** (uppercase V) to display only the virtual machines.
4. Type **`f`** to modify the fields displayed.
5. Toggle the letters so that only the following fields are selected: D, H, I, J, and K.
6. Press the space bar to return to the memory screen.
7. If necessary, stretch the `esxtop` window horizontally so that you can see all the columns.

   Leave the `esxtop` window open. You will use it soon.

Task 3: Display a memory performance chart for your test virtual machine

In this task, you will display the real-time memory performance chart for your test virtual machine. Students should perform this task individually

1. Go to the vSphere Client window. Select your test virtual machine in the inventory and click the **Performance** tab.
2. Click the **Chart Options** link. The Customize Performance Chart dialog box is displayed.
3. Configure the performance chart settings as follows:
   a. In the **Chart Options** panel, expand **Memory** and select **Real-time**.
   b. In the **Objects** panel, ensure that your test virtual machine is selected.
   c. In the **Counters** panel, click **None** to deselect all counters. Select the following check boxes: **Balloon**, **Swap out rate**, and **Swap in rate**.
   d. Click **OK**.
   e. Click the **Popup Chart** icon in the upper-right corner of the **Performance** tab.

      Leave this pop-up chart window open. You will use it soon.

Task 4: Observe your test virtual machine's memory usage

In this task, you will observe memory usage information for your test virtual machine. Students should perform this task individually

1. View memory usage statistics for your test virtual machine:
   a. Select your test virtual machine in the inventory and click the **Summary** tab.

      From the **Resources** panel, record the amount of consumed host memory: _____
2. View the amount of physical memory actively used by the virtual machine.

   From the **Resources** panel, record the amount of active guest memory: _____

   Is consumed host memory greater than active guest memory? _____

   If consumed host memory is greater than active guest memory, memory is not overcommitted.

   If consumed host is less than active guest memory, this might point to potential performance degradation.
3. Go to your test virtual machine's pop-up chart. Observe the latest values for Balloon, Swap out rate, and Swap in rate. Because currently no memory contention exists, these values should be almost zero, if not zero.
4. Go to the `esxtop` window. Observe the values for MCTLSZ, MCTLTGT, SWCUR, SWTGT, SWR/s, and SWW/s. The swap values should be near zero, if not zero.
5. Go to the console of your test virtual machine. Observe and record the opm value here: _____

Task 5: Import the RAM-HOG vApp

In this task, you will import a vApp named RAM-HOG. RAM-HOG will help generate RAM contention for your test virtual machine. Students should perform this task individually.

1. Return to the vSphere Client window. In the vSphere Client menu bar, select **File** > **Deploy OVF Template**. The Deploy OVF Template starts.

2. When prompted by the Deploy OVF Template wizard, perform the following actions.

Wizard Page	Action
Source	In the **Deploy from a file or URL** field, click **Browse**. Browse to the OVF pathname that you recorded in "Preparing for the lab." Click **Next**.
OVF Template Details	Click **Next**.
Name and Location	In the **Name** field, type **`RAM-HOG##`**, where ## is the number of your ESXi host, for example, RAM-HOG01. In the **Inventory Location** pane, select the Training datacenter and click **Next**.
Host/Cluster	Select your ESXi host in the inventory and click **Next**.
Storage	Select your local datastore, whose name you recorded in "Preparing for the lab." Click **Next**.
Disk Format	Leave the defaults and click **Next**.
Ready to Complete	Click **Finish**.

3. Monitor the OVF deployment progress. Verify that the deployment completes successfully.

   RAM-HOG is a vApp located in the inventory under your ESXi host. A number is appended to the name RAM-HOG, which corresponds to the number of your ESXi host. RAM-HOG contains 6 virtual machines, Workload11 through Workload16. The letter "a" or "b" is appended to the end of each name. Except for their names, these virtual machines are identical.

Task 6: Overcommit memory resources

In this task, you will create memory contention for your test virtual machine. Students should perform this task individually

1. Power on your RAM-HOG vApp (right-click RAM-HOG and select **Power On**.) The virtual machines in the vApp will power on.
2. Monitor the progress of the task in the **Recent Tasks** pane. While the virtual machines are powering on, open a console to each of the six virtual machines.
3. In the console of each virtual machine—Workload11 through Workload16—start the memory test:
   a. Click anywhere in the virtual machine console to change the mouse focus.
   b. At the boot prompt (boot:), press Enter. The Ultimate Boot CD V4.1.1 main menu appears.
   c. Press Enter to select Mainboard Tools.
   d. Using the down arrow key, select Memory Tests and press Enter.
   e. Using the down arrow key, select Memtest86+ V1.70 and press Enter.
   f. Press Ctrl+Alt to release mouse focus.
   g. Start the memory test in the remaining virtual machines in the vApp.
   h. Close the console of each virtual machine. The memory test will continue to run even when the console is closed.
4. In the vSphere Client window, drag your test virtual machine into your RAM-HOG vApp.

Task 7: Observe memory statistics

In this task, you will observe the memory statistics again and you will observe the effect that memory contention has on the performance of your test virtual machine. Students should perform this task individually

1. Go to your test virtual machine's pop-up chart. Observe the latest values for Balloon, Swap out rate, and Swap in rate.

   Is there ballooning activity? _____

   Is there swapping activity? _____

2. Go to the `esxtop` window. Observe the following values for your test virtual machine: MCTLSZ, MCTLTGT, SWCUR, SWTGT, SWR/s, and SWW/s.

3. Determine whether the ESXi host has reached a steady state of memory activity:

   a. Compare the values for MCTLSZ and MCTLTGT.

      Does the value for MCTLSZ converge with MCTLTGT? _____

   b. Compare the values for SWCUR and SWTGT.

      Does the value for SWCUR converge with SWTGT? _____

      If the values in each set of counters are close in value to each other, the host has reached a steady state. If the host has not reached a steady state, wait until it has before you continue.

4. Determine which virtual machines do not have the balloon driver installed: In the `resxtop` window, view the MCTL? column. This column determines whether the balloon driver is installed in the virtual machine. Y means that it is installed. N means that it is not installed.

   Which virtual machines do not have the balloon driver installed? _____

   _____

   If the balloon driver is not installed, the only way that the ESXi host can reclaim memory from the virtual machine is by swapping.

5. Determine if any of the virtual machines are swapping: View the values for SWR/s and SWW/s.

   Record the virtual machines that are swapping:_____

   _____

6. Of the virtual machines that are swapping, determine if their performance has degraded:

   a. In the `resxtop` window, type **c** to display the CPU screen.

   b. View the %SWPWT column.

      As this value exceeds 5 percent, performance of the virtual machine will degrade significantly.

      Does this value for any of the virtual machines listed exceed 5 percent? If so, record the virtual machines here:

      _____

7. Go to the console of your test virtual machine. Observe and record the opm value: _____

   Compare the current opm value with your baseline value.

   Has the performance of your application degraded? _____

Task 8: Clean up for the next lab

In this task, you will clean up your desktop in preparation for the next lab. Students should perform this task individually

1. Close all pop-up chart windows.
2. Leave the `starttest4` script running in your test virtual machine. You will use it for the next lab.
3. Leave your test virtual machine in the RAM-HOG vApp.
4. Leave the console to your test virtual machine open.
5. Leave your RAM-HOG vApp powered on.
6. Leave the vSphere Client open.
7. Leave the `esxtop` window open.
8. Leave `esxtop` running.

Lab 15

Diagnosing Memory Performance

Objective: Use the performance troubleshooting checklist to detect possible memory performance problems

In this lab, you will perform the following tasks:

1. Generate memory activity.
2. Display the memory performance charts for your ESXi host and virtual machines.
3. Check for active host-level swapping.
4. Check for past host-level swapping.
5. Check for guest operating system paging.
6. Check for high guest memory demand.
7. Summarize your findings.
8. Clean up for the next lab.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name	_____
Team vCenter Server Administrator password	_____
Your test virtual machine name	_____
Root password for the test virtual machine	_____
VMware vSphere® ESXi™ host name	_____
ESXi host root password	_____

Task 1: Generate memory activity

In this task, you will verify that database activity is being generated. Students should perform this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your team vCenter Server system as user Administrator. Use the Administrator password recorded in "Preparing for the lab."
2. Go to the console of your test virtual machine. You recorded the name of your test virtual machine in "Preparing for the lab." You should be logged in with a terminal window open. Verify that the `starttest4` script is still running. If it is not, restart the script by running the following command:

   ```
   $ ./starttest4
   ```

3. Verify that your RAM-HOG vApp is still powered on and that your test virtual machine is a member of the vApp.

Task 2: Display the memory performance charts for your ESXi host and virtual machines

In this task, you will open pop-up charts to your ESXi host and virtual machines so that they display memory swap statistics. Students should perform this task individually.

1. In the vSphere Client window, select your ESXi host in the inventory and click the **Performance** tab.
2. Click **Advanced**, then click the **Chart Options** link. The Customize Performance Chart dialog box is displayed.
   a. In the **Chart Options** panel, expand **Memory** and select **Real-time**.
   b. In the **Chart Type** panel, select **Line graph**.
   c. In the **Objects** panel, ensure that your ESXi host is selected.
   d. In the **Counters** panel, click **None** to deselect the current counters. Select the **Swap out rate**, **Swap in rate**, **Balloon**, and **Swap used** check boxes.
   e. Click **OK**.
   f. Click the **Popup Chart** icon in the upper-right corner of the **Performance** tab.
3. Display a memory pop-up chart for the virtual machines on the ESXi host:
   a. Select your ESXi host in the inventory. Click the **Performance** tab. Click **Advanced**. The most recently accessed performance chart is displayed.
   b. Click the **Chart Options** link. The Customize Performance Chart dialog box is displayed.
   c. In the **Chart Options** panel, expand **Memory** and select **Real-time**.
   d. In the **Chart Type** panel, select **Stacked Graph (per VM)**.
   e. In the **Objects** panel, click **None** to deselect all the objects. Select your test virtual machine, as well as Workload11 through Workload16.
   f. In the **Counters** panel, click **None** to deselect all the counters. Select the **Swap in rate** check box. Although you want to observe Swap out rate as well, you can view only one counter at a time in a stacked graph.
   g. Click **OK**.
   h. Click the **Popup Chart** icon in the upper-right corner of the **Performance** tab.

Task 3: Check for active host-level swapping

In this task, you will use the vSphere Client and `esxtop` to check to see whether the test virtual machine is actively swapping memory. Students should perform this task individually.

1. Measure your ESXi host's swap in and swap out rates:

   a. In your ESXi host pop-up chart, view the latest values for Swap out rate and Swap in rate. Record the values here: _____

   b. In the `esxtop` window, type **`m`** to display the memory screen. In the SWAP/MB line located near the top of the screen, record the value for curr: _____

      Is your ESXi host swapping? (That is, are any of the values > 0?) _____

      If the answer is yes, the ESXi host is actively swapping virtual machine memory. The next step is to determine whether this swapping is directly affecting a particular virtual machine.

      If the answer is no, the ESXi host is not currently swapping virtual machine memory.

2. Measure the swap in rate and swap out rate of your virtual machines:

   a. Go to the virtual machine comparison pop-up chart. View the latest values for Swap in rate for your test virtual machine as well as for Workload11 through Workload16.

   b. Open a new pop-up chart to also view the latest values for Swap out rate.

   c. Go to the `esxtop` window, check the values SWR/s and SWW/s for your test virtual machine as well as for Workload11 through Workload16.

      Is your test virtual machine swapping? (Are any of the observed values > 0?) _____

      If the answer is yes, virtual machine memory swapping is directly affecting your test virtual machine.

Task 4: Check for past host-level swapping

In this task, you will check to see whether your test virtual machine has swapped in the past. Students should perform this task individually.

1. Check for past swapping on your ESXi host:
   a. Go to the ESXi host pop-up chart. View the average value for Swap used.
   b. Go to the `esxtop` window. In the SWAP/MB line, near the top of the screen, view the counter named curr.

      Has your ESXi host swapped in the past (value > 0)? _____

      If the answer is yes, the ESXi host has swapped virtual machine memory in the past. That swapping might be an indication of potential performance problems.

      If the answer is no, the ESXi host does not currently have any virtual machine memory swapped.
2. Check for past swapping in the virtual machines on your ESXi host:
   a. Open a new virtual machine comparison pop-up chart to view the latest values for Swap used.
   b. Go to the `esxtop` window. View the value of SWCUR for your test virtual machine.

      Has your test virtual machine swapped in the past (value > 0)? _____

      If the answer is yes, the ESXi host has swapped memory from your test virtual machine.

Task 5: Check for guest operating system paging

In this task, you will check to see whether the guest operating system in your test virtual machine is paging. Students should perform this task individually.

1. Check for ballooning on the host:
   a. Go to the ESXi host pop-up chart. View the latest value for Balloon.
   b. Go to the `esxtop` window. Near the top of the screen, check the curr value in the MEMCTL/MB line.

      Is your ESXi host ballooning? _____

      If the answer is yes, a high demand for host memory might exist.

      If the answer is no, high demand for the host's memory is not present.
2. Check for ballooning in the virtual machine:
   a. Open a new virtual machine comparison pop-up chart to view the latest values for Balloon.
   b. In the `esxtop` window, view the MCTLSZ counter for your test virtual machine.

      Is your 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 swapping in the guest operating system.
3. Use a tool in the test virtual machine's guest operating system to determine if swapping is occurring:
   a. Go to the test virtual machine console and open a second terminal window.
   b. At the command prompt, run the following command:

      ```
      vmstat 3 20
      ```

      Where 3 is the sampling interval in seconds and 20 is the number of samples.

      View the si and so columns (swap-in and swap-out). If you see values greater than 0, the guest operating system is swapping.

Task 6: Check for high guest memory demand

In this task, you will check to see whether demand for memory in your test virtual machine is high. Students should perform this task individually.

1. Check your test virtual machine's memory usage:
   a. Go to the `resxtop` window. View the MEMSZ and GRANT counters for your test virtual machine.The GRANT value divided by the MEMSZ value equals the percentage of memory used
   b. Open a new virtual machine comparison pop-up chart to view the latest values for Usage. In particular, review the Maximum and Average columns in the chart.

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

      _____

      (Use the performance chart to answer this question instead of `resxtop`.)

      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.

Task 7: Summarize your findings

In this task, you will summarize your findings. Students should perform this task individually.

1. Answer the following questions:
   a. Is there a memory problem on the ESXi host?
   b. If a memory problem exists, is it affecting your test virtual machine?
2. Explain your answer.

Task 8: Clean up for the next lab

In this task, you will clean up your desktop in preparation for the next lab. Students should perform this task individually.

1. In the inventory, drag your test virtual machine from your RAM-HOG vApp to your ESXi host.
2. Modify your test virtual machine so that it has only one virtual CPU:
   a. Shut down your test virtual machine. Wait for the virtual machine to power off.
   b. Right-click your test virtual machine in the inventory and select **Edit Settings**.
   c. Change the number of virtual sockets from 4 to 1.

      Leave your test virtual machine powered off.

      Close the test virtual machine console.
3. Close all pop-up chart windows.
4. Power off your RAM-HOG vApp (right-click the vApp and select **Power Off**).
5. Remove your RAM-HOG vApp from the inventory. Right-click the RAM-HOG vApp and select **Remove from Inventory**. Click **Yes** to confirm the removal from the inventory of the vApp and the virtual machines in it.
6. In the ESXi host PuTTY session, stop `esxtop` (Ctrl+C).
7. Close the vMA window (type **`exit`** at the command prompt.)
8. Leave the vSphere Client window open.

Lab 16

Diagnosing Virtual Machine and Cluster Performance

Objective: Detect possible virtual machine and vSphere HA cluster problems

In this lab, you will perform the following tasks:

1. Move your ESXi host into the first problem cluster.
2. Troubleshoot the first cluster problem.
3. Troubleshoot the second cluster problem.
4. Prepare for the next lab.

Preparing for the lab

Record the following information:

Team VMware® vCenter Server™ system name _____

Team vCenter Server Administrator password _____

VMware vSphere® ESXi™ host name _____

First virtual machine name for Cluster1 _____

Second virtual machine name for Cluster1 _____

First virtual machine name for Cluster2 _____

Second virtual machine name for Cluster2 _____

Task 1: Move your ESXi host into the first problem cluster

In this task, you will move your ESXi host into the cluster named Cluster1. Cluster1 has been preconfigured for you. Students should do the steps in this task individually.

1. If the VMware vSphere® Client™ is not already active, use it to log in to your team vCenter Server system as user Administrator. Use the Administrator password recorded in "Preparing for the lab."
2. Select **Home** > **Inventory** > **Hosts and Clusters**.
3. Verify that all of the virtual machines on your ESXi host are powered off. If any of your virtual machines are powered on, then shut them down.
4. In the Training datacenter, expand the folder named Lab16-UseWhenInstructed. This folder contains two cluster objects, Cluster1 and Cluster2.
5. Drag and drop your ESXi host into the cluster named Cluster1. The Add Host wizard appears.
6. In the Choose the Destination Resource Pool page, select **Create a new resource pool for this host's virtual machines and resource pools...** Keep the default name and click **Next**.
7. In the Ready to Complete page, click **Finish**.
8. Verify that both your host and your partner's host are located in Cluster1. Wait until both hosts are part of the cluster before continuing.

Task 2: Troubleshoot the first cluster problem

In this task, you will troubleshoot your first cluster problem. The problem is that one or more of your virtual machines will not be able to power on. Students should do the steps in this task individually.

1. In the Hosts and Clusters inventory, select Cluster1.

2. Select the **Summary** tab. Record the following information:

   Total CPU Resources: _____

   Total Memory: _____

   Configured CPU Failover Capacity: _____

   Configured Memory Failover Capacity: _____

   Based on the information in the vSphere HA (VMware vSphere® High Availability) panel, what admission control policy is enabled? _____

3. Under the Cluster1 inventory object, expand your resource pool (called "Grafted from <your ESXi host>").
4. Find the two virtual machines for Cluster1 whose names you recorded in "Preparing for the lab."
5. Power on the first virtual machine for Cluster1.

   Does your virtual machine power on successfully? Why or why not?

6. Power on the second virtual machine for Cluster1.

   Does your virtual machine power on successfully? Why or why not?

   If a failure was generated for either the first or second virtual machine, what was the error message?

7. Determine why your virtual machine did not power on.
   a. View the cluster's **Summary** tab.

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

   b. For each resource pool in Cluster1, view the resource pool's **Resource Allocation** tab. View the allocation of CPU and memory resources.

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

   c. What are possible solutions to the problem?

8. After you have determined the reason, ensure that both of your virtual machines are powered off.

Task 3: Troubleshoot the second cluster problem

In this task, you will troubleshoot your second cluster problem. The problem is that one of your virtual machines will not be able to power on. Students should do the steps in this task individually.

1. Put your ESXi host in maintenance mode:
   a. Right-click your ESXi host and select **Enter Maintenance Mode**.
   b. *Deselect* the check box **Move powered off and suspended virtual machines to other hosts in the cluster** and click **Yes**.

      CAUTION

      Make sure that you deselect the check box. If you leave the check box selected, your virtual machines will be migrated to your partner's ESXi host.

   c. If a warning message appears referring to the DRS cluster, click **OK**.

2. Drag and drop your ESXi host from Cluster1 to the Training datacenter.

   NOTE

   The resource pool remains in Cluster1. This is OK. You will recreate the resource pool when you add your ESXi host to Cluster2.

3. Drag and drop your ESXi host into Cluster2. The Add Host wizard appears.
4. In the Choose the Destination Resource Pool page, select **Create a new resource pool for this host's virtual machines and resource pools...** Keep the default name and click **Next**.
5. In the Ready to Complete page, click **Finish**.
6. Take your ESXi host out of maintenance mode. Right-click your ESXi host and select **Exit Maintenance Mode**.
7. Select Cluster2 and click the **Summary** tab.

   Based on the information in the vSphere HA panel, what is the admission control policy used in this cluster? _____

8. In the inventory, find the two virtual machines for Cluster2 whose names you recorded in "Preparing for the lab."
9. Power on the first virtual machine for Cluster2.

   Does your virtual machine power on successfully? Why or why not?

   Wait for your partner to finish this step before continuing.

10. Power on the second virtual machine for Cluster2.

    Does your virtual machine power on successfully? Why or why not?

    If a failure was generated for either the first or second virtual machine, what was the error message?

11. Determine why the virtual machine did not power on.

    a. View the cluster's **Summary** tab.

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

    b. For each resource pool in Cluster2, view the resource pool's **Resource Allocation** tab. View the allocation of CPU and memory resources.

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

    c. View the cluster's **Summary** tab. Click the cluster's **Advanced Runtime Info** link.

       What is the slot size?

       Is the slot size large enough to accommodate the two virtual machines for Cluster2? Why or why not?

       Are there enough slots available to power on both of your virtual machines?

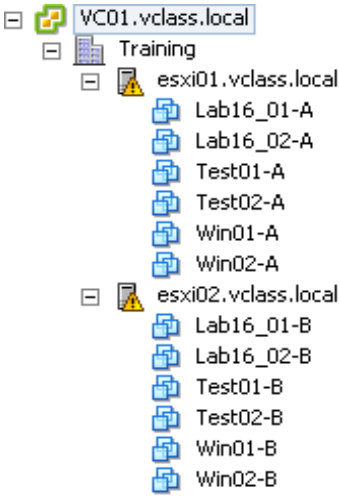
    d. What do you think is preventing you from powering on your second virtual machine?

    e. What are possible solutions to the problem?

Task 4: Prepare for the next lab

In this task, you will prepare your inventory for the next lab. Students should do the steps in this task individually.

1. Shut down your virtual machines that are powered on.
2. Put your ESXi host in maintenance mode:
   a. Right-click your ESXi host and select **Enter Maintenance Mode**. If you get a cluster failover warning, click **Yes**.
   b. Deselect the check box **Move powered off and suspended virtual machines to other hosts in the cluster** and click **Yes**.
   c. If a warning message appears referring to the DRS cluster, click **OK**.
3. Drag and drop your ESXi host back into the Training datacenter.
4. Take your ESXi host out of maintenance mode.
5. Remove the folder "Lab16-UseWhenInstructed" from the inventory.
6. Wait for your partner's ESXi host to be moved back to the Training datacenter. Verify that the team vCenter Server inventory looks like the following:

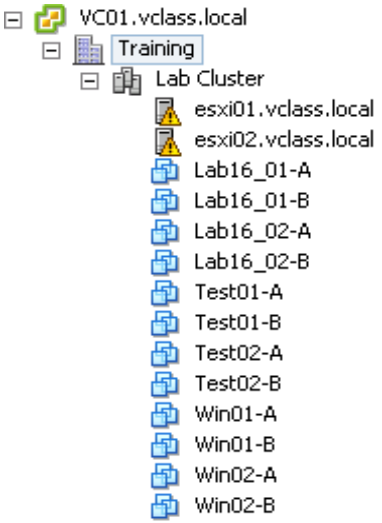


7. Work together with your partner and create a cluster in the Training datacenter named Lab Cluster:
   a. In the inventory, right-click the **Training** datacenter and select **New Cluster**.
   b. When prompted by the New Cluster wizard, perform the following actions.

Wizard page	Action
Cluster Features	In the Name field, type **Lab Cluster**. Click **Turn On vSphere HA** and **Turn On vSphere DRS**. Click **Next**.
Remaining wizard pages	Leave default selections and click **Next**.
Ready to Complete	Click **Finish**.

8. After the cluster is created, drag your ESXi host into Lab Cluster. In the Add Host wizard, keep the default selection for destination resource pool.
9. Ensure your ESXi host out of maintenance mode.

   The vCenter Server inventory should look similar to the following:



Leave the vSphere Client window open.

Lab 17
Working with Host Profiles

Objective: Synchronize ESXi host configurations

In this lab, you will perform the following tasks:

1. Create a host profile.
2. Attach a host profile to an ESXi host and check compliance.
3. Purposely introduce configuration drift.
4. Check compliance again.
5. Remediate the managed host.
6. Detach the managed host from the host profile.

Preparing for the lab

Your instructor will provide you with the following information:

Team VMware® vCenter Server™ system name _____

Team vCenter Server Administrator password _____

Reference host _____

Managed host _____

vmnic _____

Task 1: Create a host profile

In this task, you will build a host profile based on the configuration of a reference host in the vCenter Server inventory. Students should perform this lab as a team. Student A should do the steps in this task.

NOTE

For each host, two of the private LUNs are used by the private VMware vSphere® VMFS datastore on each host. Host profiles are *not* designed to address problems like private logical unit numbers (LUNs). For example, whether a LUN is private and presents a configuration problem in the *physical* infrastructure. Host profiles are designed to manage configuration settings in the *virtual* infrastructure.

1. If the VMware vSphere® Client™ is not already active, log in to the team vCenter Server system as user Administrator. Use the password that you recorded in "Preparing for the lab."
2. Verify that both of your VMware vSphere® ESXi™ hosts are in the cluster named Lab Cluster.
3. Select **Home** > **Management** > **Host Profiles**.
4. In the task bar, click **Create Profile**.
5. When prompted by the Create Profile wizard, perform the following actions.

Wizard page	Action
Select Creation Method	Select **Create Profile from existing host** and click **Next**.
Specify Reference Host	Expand the inventory and select the reference host that you recorded in "Preparing for the lab." Click **Next**.
Profile Details	In the **Name** field, type **`Our Host Profile`**. No description is necessary. Click **Next**.
Ready to Complete	Click **Finish**.

Task 2: Attach a host profile to an ESXi host and check compliance

In this task, you will attach the host profile to the managed host and check for compliance. Student B should do the steps in this task.

1. If the vSphere Client is not already active, log in to the team vCenter Server system as user Administrator. Use the password that you recorded in "Preparing for the lab."
2. Select **Home** > **Inventory** > **Hosts and Clusters**.

3. In the inventory, select the managed host that you recorded in "Preparing for the lab." Click the **Virtual Machines** tab.
4. Shut down all virtual machines that are powered on. Wait for all virtual machines to shut down and power off.

   TIP

   To shut down multiple virtual machines at the same time, sort the list of virtual machines by state so that all the powered-on virtual machines are sequential in the list. Select the first powered-on virtual machine. Press the Shift key and click the last powered-on virtual machine in the list. Right-click the last powered-on virtual machine in the list and select **Power** > **Shut Down Guest**.
5. In the inventory, right-click the managed host and select **Enter Maintenance Mode**. Leave the check box **Move powered off and suspended virtual machines to other hosts in the cluster** selected. Click **Yes** to confirm entering maintenance mode. If a DRS cluster warning appears, click **OK**.
6. Select **Home** > **Management** > **Host Profiles**.
7. Right-click **Our Host Profile** and select **Attach Host/Cluster**.
8. Expand the inventory and select the managed host.
9. Click **Attach** and click **OK**.
10. Select **Our Host Profile**.
11. In the **Our Host Profile** pane, click the **Hosts and Clusters** tab.
12. Select the managed host and click the **Check Compliance** link. Review the compliance failures.

NOTE

Almost every compliance failure in the screenshot is related to the fact that the hosts have private LUNs. Ignore all of these compliance failures for the remainder of this lab.

If you see compliance failures other than those in the screenshot, your two hosts are not configured identically. These failures are OK because you are going to use host profiles to bring your managed host into compliance with the host profile. But notice these additional compliance failures.

Task 3: Purposely introduce configuration drift

In this task, you will purposely modify the configuration of the managed host so that it is not in compliance with the host profile that you created in task 1. Student A should do the steps in this task.

1. Select **Home** > **Inventory** > **Hosts and Clusters**.
2. Select the managed host and click the **Configuration** tab.
3. In the **Hardware** panel, click the **Networking** link.
4. Click **vSphere Distributed Switch**.
5. Click the **Manage Physical Adapters** link. The Manage Physical Adapters dialog box is displayed.
6. Find the vmnic you recorded in "Preparing for the lab."
7. Click the **Remove** link next to that vmnic. Click **Yes** to confirm the removal.
8. Click **OK**.

Task 4: Check compliance again

In this task, you will check for compliance again and look for the configuration failures introduced in task 3. Student B should do the steps in this task.

1. Select **Home** > **Management** > **Host Profiles**.
2. Select **Our Host Profile**.
3. In the **Our Host Profile** pane, click the **Hosts and Clusters** tab.
4. Select the managed host and click the **Check Compliance** link**.** Review the compliance failures. In addition to the compliance failures that you first saw in task 2, you should see the following compliance failure:

   ```
   Uplink not connected to the expected physical NIC on vDS-01
   ```

   The compliance failure message is the direct result of the configuration drift that you introduced in task 3.

Task 5: Remediate the managed host

In this task, you will apply your host profile to bring the managed host into compliance. Student A should do the steps in this task.

1. Select **Home** > **Management** > **Host Profiles**.
2. Select **Our Host Profile**.
3. Click the **Hosts and Clusters** tab.
4. Select the managed host and click the **Apply Profile** link**.**
5. When prompted by the Apply Profile wizard, perform the following actions.

Field/Setting	Action
Software iSCSI Initiator Selection	Keep the default and click **Next**.
Initiator IQN	Keep the default and click **Next**.
Initiator Alias	Keep the default and click **Next**.

6. Review the configuration changes to be applied and click **Finish**.
7. In the **Recent Tasks** pane, monitor the process as changes are applied to the managed host.
8. View the status of the managed host in the **Hosts and Clusters** tab.

   NOTE

   Ordinarily, you should see the status change to Compliant. Because your hosts have private LUNs, it is impossible for host profiles to bring the managed host entirely into compliance. Even with the private LUNs, the compliance failure message related to the distributed switch should disappear after applying the host profile.

9. Select **Home** > **Inventory** > **Hosts and Clusters**.
10. Select the managed host and click the **Configuration** tab.
11. Click the **Networking** link.
12. Verify that the vmnic that you removed in task 3 has been re-added to the distributed switch.
13. Right-click the managed host in the inventory and select **Exit Maintenance Mode**.

Task 6: Detach the managed host from the host profile

In this task, you will detach the managed host from the host profile. Student B should do the steps in this task.

1. Select **Home** > **Management** > **Host Profiles**.
2. Right-click **Our Host Profile** and select **Attach Host/Cluster**.
3. In the **Attached Entities** pane, select the managed host.
4. Click **Detach** and click **OK**.
5. Select **Home > Inventory > Hosts and Clusters**.
6. Leave the vSphere Client window open for the next lab.

Lab 18

Using Windows PowerShell

Objective: Use vSphere PowerCLI to run basic Windows PowerShell cmdlets

In this lab, you will perform the following tasks:

1. Start vSphere PowerCLI and find the vSphere PowerCLI version.
2. Retrieve the Windows PowerShell security policy.
3. Create a simple script.
4. Display the vSphere PowerCLI help files.
5. Connect and disconnect to your ESXi host.
6. Define a variable to store the ESXi host and vCenter Server system names.
7. Connect to the vCenter Server system.
8. Run cmdlets to find ESXi host-related information.
9. List the datastores on an ESXi host.
10. List the properties of a virtual switch.
11. Use Get-VM to retrieve virtual machine properties.
12. Use Get-Stat to retrieve performance information.
13. Migrate a virtual machine's disk to shared storage.
14. Use vMotion to migrate a virtual machine.

Preparing for the lab

Record the following information:

Your VMware® vCenter Server™ system name _____

Your vCenter Server Administrator password _____

Your VMware vSphere® ESXi™ host name _____

Your partner's ESXi host name _____

Virtual machine name _____

Shared datastore name _____

Task 1: Start vSphere PowerCLI and find the vSphere PowerCLI version

In this task, you will start VMware vSphere® PowerCLI™ and you will find the version and the vSphere PowerCLI cmdlets installed on your desktop. Students should perform this task individually.

1. On your vCenter Server desktop, double-click the **VMware vSphere PowerCLI** icon. The vSphere PowerCLI window appears.
2. Find the version of vSphere PowerCLI.

   ```
   PowerCLI C:\> Get-PowerCLIVersion
   ```

   NOTE

   vSphere PowerCLI commands are not case-sensitive.
3. Retrieve all the Windows PowerShell commands.

   ```
   PowerCLI C:\> Get-Command
   ```
4. Retrieve all the Windows PowerShell commands with the `more` option.

   ```
   PowerCLI C:\> Get-Command | more
   ```
5. Retrieve a list of all the vSphere PowerCLI commands.

   ```
   PowerCLI C:\> Get-VICommand
   ```
6. Retrieve a list of all the vSphere PowerCLI commands in a readable list format.

   ```
   PowerCLI C:\> Get-VICommand | Format-List | more
   ```

Task 2: Retrieve the Windows PowerShell security policy

In this task, you will retrieve the Windows PowerShell security policy. Students should perform this task individually.

1. Retrieve the security policy set for Windows PowerShell.

   ```
   PowerCLI C:\> Get-ExecutionPolicy
   ```

2. Retrieve detailed information about the execution policy for the shell.

   ```
   PowerCLI C:\> Get-Help Get-ExecutionPolicy
   ```

Task 3: Create a simple script

In this task, you will write a script with a function that will ask your name and display your name. Students should perform this task individually.

1. From your PowerCLI window, make a directory named C:\Scripts.

   ```
   PowerCLI C:\> mkdir C:\Scripts
   ```

2. Make `C:\Scripts` your current working directory.

   ```
   PowerCLI C:\> cd C:\Scripts
   ```

3. From your vCenter Server desktop, click **Start** > **Run**.
4. Type **`notepad`** and press Enter.
5. Type the following script:

   ```
   Function Name
   {
   $name = Read-Host "Enter your name"
   Write-host “Welcome $name to the Optimize and Scale class”
   }
   Name
   ```

6. Save the script in the `C:\Scripts` directory. In the **Save as Type** drop-down menu, select **All Files**. Name the file `Name.ps1`. Click **Save** and exit notepad.
7. At the command prompt, run the script:

   ```
   PowerCLI C:\Scripts> .\Name.ps1
   ```

8. At the command prompt, run the script using the function `Name`.

   ```
   PowerCLI C:\Scripts> .\Name
   ```

9. Verify that the script runs without error.
10. From your vCenter Server desktop, click **Start** > **Run**.
11. Type **notepad** and press Enter.
12. Type the following script, which displays the Fibonacci series:

```
Function Fibonacci
{
Write-host "inside"
$vals = (1..5)
[int]$a = 0
[int]$b = 1
Write-host "$a"
Write-host "$b"
foreach ($x in $vals)
{
[int]$res = [int]$a+[int]$b
Write-host "$res"
[int]$a = [int]$b
[int]$b = [int]$res
}
}
Fibonacci
```

13. Save the script in the `C:\Scripts` directory. Name the file `fibonacci.ps1`.
14. Run the script from the vSphere PowerCLI command prompt. Verify that the script runs without error.
15. Make `C:\` your current working directory.

```
PowerCLI C:\Scripts> cd C:\
```

Task 4: Display the vSphere PowerCLI help files

In this task, you will display the vSphere PowerCLI cmdlet help files. Students should perform this task individually.

1. Display help about the Windows PowerShell cmdlets and concepts.

   ```
   PowerCLI C:\> Get-Help | more
   ```

   Press the space bar to display a screenful of output at a time. Press Return to display one line of output at a time. To end the command, scroll to the end of the output or press **q** at any time.

2. Retrieve information about a specific cmdlet, `Get-VMHost`.

   ```
   PowerCLI C:\> Get-Help Get-VMHost
   ```

Task 5: Connect and disconnect to your ESXi host

In this task, you will connect and disconnect to your ESXi host. Students should perform this task individually.

1. Connect to your ESXi host. Your recorded your ESXi host name in "Preparing for the lab." Type the command on a single line.

   ```
   PowerCLI C:\> Connect-VIServer -Server <ESXi_host_name>
   -User root -Password <password>
   ```

   Specify your ESXi host name in the same way that it is defined in the vCenter Server inventory, for example, esxi01.vclass.local. Replace <password> with the ESXi host root password that you recorded in "Preparing for the lab."

2. Verify that the connection to the server has succeeded.

   ```
   PowerCLI C:\> Get-VMHost
   ```

3. Disconnect from the ESXi host. Type the command on a single line.

   ```
   PowerCLI C:\> Disconnect-VIServer -Server <ESXi_host_name>
   ```

   When prompted to confirm the action, press Enter to accept the default of Yes.

   NOTE

   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 were using the VMware vSphere® Client™.

Task 6: Define a variable to store the ESXi host and vCenter Server system names

In this task, you will create a variable to store the ESXi host name and the vCenter Server system name. Students should perform this task individually.

1. Define a variable to store the ESXi host name.

   ```
   PowerCLI C:\> $vmHost = "<ESXi_host_name>"
   ```

   Specify the ESXi host name in the same way that it is defined in the vCenter Server inventory, for example, esxi01.vclass.local.

2. Define a variable to store the vCenter Server system name.

   ```
   PowerCLI C:\> $vCenter = "<vCenter_Server_name>"
   ```

Task 7: Connect to the vCenter Server system

In this task, you will connect to the vCenter Server system. Students should perform this task individually.

1. Define a variable to store the vCenter Server credential.

   ```
   PowerCLI C:\> $vcCred = Get-Credential
   ```

   When prompted, enter user Administrator and Administrator's password.

2. Connect to the vCenter Server system.

   ```
   PowerCLI C:\> Connect-VIServer -Server $vCenter
   -Credential $vcCred
   ```

   TIP

   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 as well.

Task 8: Run cmdlets to find ESXi host-related information

In this task, you will run some basic cmdlets to retrieve basic information, such as finding the number of CPUs, the amount of memory, and the version of the ESXi host. Students should perform this task individually.

1. Create a variable to store the ESXi host name.

   ```
   PowerCLI C:\> $ESXi1=Get-VMHost $vmhost
   ```

2. Find the version of ESXi host.

```
PowerCLI C:\> $ESXi1.Version
```

or

```
PowerCLI C:\> Get-VMHost -Name $vmHost| Select Name,
@{Name="Product";Expression={$_.ExtensionData.Config.Product.Name}}
, Version
```

3. Find the number of CPUs on the ESXi host.

```
PowerCLI C:\> Get-VMHost -Name $vmHost | Select numcpu | Format-List
```

4. Find the capacity of CPU on the ESXi host.

```
PowerCLI C:\> $ESXi1.CpuTotalMhz
```

or

```
PowerCLI C:\> Get-VMHost -Name $vmHost |Select CpuTotalMhz | Format-
List
```

5. Find the memory capacity of the ESXi host.

```
PowerCLI C:\> $ESXi1.MemoryTotalMB
```

or

```
PowerCLI C:\> Get-VMHost -Name $vmHost |Select MemoryTotalMB |
Format-List
```

6. Find the processor type of the ESXi host.

```
PowerCLI C:\> $ESXi1.ProcessorType
```

or

```
PowerCLI C:\> Get-VMHost -Name $vmHost | Select ProcessorType
```

Task 9: List the datastores on an ESXi host

In this task, you will list the datastores on an ESXi host. Students should perform this task individually.

1. Return a list of datastores that this ESXi host can access.

```
PowerCLI C:\> Get-VMHost $vmHost | Get-DataStore
```

2. List any datastore that is not accessible. This command might not return results.

```
PowerCLI C:\> Get-Datastore | Where { -not $_.State}
```

Task 10: List the properties of a virtual switch

In this task, you will list the properties of a virtual switch. Students should perform this task individually.

1. List all of the available virtual switches on an ESXi host.

   ```
   PowerCLI C:\> Get-VMHost $vmHost | Get-VirtualSwitch
   ```

2. List the available port groups on the virtual switches.

   ```
   PowerCLI C:\> Get-VMhost $vmHost | Get-VirtualSwitch | Get-
   VirtualPortgroup
   ```

3. List all of the virtual machine adapters and the networks to which they are connected.

   ```
   PowerCLI C:\> Get-VM | Get-NetworkAdapter
   ```

4. Show the switch port usage of all virtual switches on your ESXi host.

   ```
   PowerCLI C:\> Get-VirtualSwitch -VMHost $vmHost | Measure-Object -
   sum numports*
   ```

Task 11: Use Get-VM to retrieve virtual machine properties

In this task, you will retrieve information about virtual machines. Students should perform this task individually.

1. Use the `Get-VM` and `Get-Member` cmdlets to determine the properties that can be returned about a virtual machine.

   ```
   PowerCLI C:\> 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.

   ```
   PowerCLI C:\> Get-VM | Select Name, Powerstate, VMHost
   ```

3. Retrieve all the virtual machine properties in one command.

   ```
   PowerCLI C:\> Get-VM | fl *
   ```

Task 12: Use Get-Stat to retrieve performance information

In this task, you will use the `Get-Stat` cmdlet to retrieve performance information about a virtual machine. You will also write the output to an HTML file and a CSV file. Students should perform this task individually.

1. Create a variable to store the virtual machine name that you recorded in “Preparing for the lab.”

   ```
   PowerCLI C:\> $vm = “<virtual_machine_name>”
   ```

2. Using the vSphere Client window, verify that the virtual machine is powered on.
3. Monitor this virtual machine for performance and collect one performance sample from each of the major subsystems.

   ```
   PowerCLI C:\> Get-VM $vm | Get-Stat -MaxSamples 1
   -Realtime | Format-Table -autosize
   ```

4. Run the command without the format table option and output the results to an HTML file. Save the file with the name `vmresults.html` in the `C:\scripts` directory (you created the `scripts` directory in task 3.)

   ```
   PowerCLI C:\> Get-VM $vm | Get-Stat -MaxSamples 1          -Realtime
   | Convertto-Html | Out-File “C:\scripts\vmresults.html"
   ```

5. Open the file in a Web browser to view the results.
6. Run the command, changing `Convertto-HTML` to `Out-GridView`.

   ```
   PowerCLI C:\> Get-VM $vm | Get-Stat -MaxSamples 1          -Realtime|
   Out-GridView
   ```

7. Close the grid view.
8. Change the command to output the results to a CSV file in the `C:\scripts` directory.

   ```
   PowerCLI C:\> Get-VM $vm | Get-Stat -MaxSamples 1          -Realtime|
   Export-CSV "C:\scripts\vmresults.Csv"
   ```

9. Using Windows Explorer, browse to the `C:\Scripts` directory and open the file to view its contents.

Task 13: Migrate a virtual machine’s disk to shared storage

In this task, you will migrate a virtual machine’s disk to shared storage while the virtual machine is powered on. Students should perform this task individually.

1. Ensure that the virtual machine is powered on (recall that you set the variable $vm in task 12).

   ```
   PowerCLI C:\> Get-VM $vm
   ```

   If the virtual machine is powered off, power it on:

   ```
   PowerCLI C:\> Get-VM $vm | Start-VM
   ```

2. List the datastore on which the virtual machine’s disk is located.

   ```
   PowerCLI C:\> Get-VM $vm | Select Name, {$_ |
   Get-DataStore }
   ```

3. Use the `Move-VM` cmdlet to migrate the virtual machine's disk from its current datastore to the shared datastore, whose name you recorded in "Preparing for the lab."

   ```
   PowerCLI C:\> Get-VM $vm | Move-VM -datastore
   <shared_datastore_name>
   ```

4. Verify that the virtual machine's disk has been relocated.

   ```
   PowerCLI C:\> Get-VM $vm | Select Name, {$_ |
   Get-DataStore }
   ```

Task 14: Use vMotion to migrate a virtual machine

In this task, you will use VMware vSphere® vMotion® to migrate a virtual machine. Students should perform this task individually.

1. Verify that the virtual machine is powered on.

   ```
   PowerCLI C:\> Get-VM $vm
   ```

2. Use the `Set-VM` cmdlet to disconnect any CD-ROM devices that are connected to the virtual machine.

   ```
   PowerCLI C:\> Get-VM $vm | Get-CDDrive | Set-CDDrive     -
   Connected:$false
   ```

3. Use the `Move-VM` cmdlet to migrate your virtual machine to your partner's ESXi host, whose name you recorded in "Preparing for the lab."

   ```
   PowerCLI C:\> Get-VM $vm | Move-vm -destination
   <partner_ESXi_host_name>
   ```

   Specify your partner's ESXi host name in the same way that it is defined in the vCenter Server inventory, for example, esxi02.vclass.local.

4. Verify that the virtual machine now resides on the partner team's ESXi host.

   ```
   PowerCLI C:\> Get-VM $vm | Select Name, VMhost
   ```

5. Keep the vSphere PowerCLI window open.

Lab 19
Using Image Builder

Objective: Use Image Builder to export an image profile

In this lab, you will perform the following tasks:

1. Export an image profile to an ISO image.

Preparing for the lab

Record the following information:

Lab partner	_____
Team VMware® vCenter Server™ fully qualified domain name	_____
Team vCenter Server Administrator password	_____
Software depot file path	_____

NOTE

For this lab, you will work with a lab partner, whose name you recorded in this section.

Task 1: Export an image profile to an ISO image

In this task, you will log in to VMware vSphere® PowerCLI™, add an offline depot, clone an image profile, and export the profile to an ISO image. Students should perform this task as a team. Designate one student in the team to perform this task.

1. Go to your vSphere PowerCLI window. If you closed your vSphere PowerCLI window, then perform the following steps to reconnect to vSphere PowerCLI:

   a. On your vCenter Server desktop, double-click the **VMware vSphere PowerCLI** icon. The vSphere PowerCLI window is displayed.

   b. Use the `Connect-VIServer` command to connect to the team vCenter Server system. Type the following command:

      `PowerCLI C:\>` **`connect-viserver <vCenter_Server_FQDN>`**

      where <vCenter_Server_FQDN> is your team vCenter Server system's fully qualified domain name, which you recorded in "Preparing for the lab."

      If vSphere PowerCLI asks if you want to work with multiple default servers, type **y**.

      If prompted, log in as user Administrator with the Administrator password that you recorded in "Preparing for the lab." The command returns a table that specifies the name of the team vCenter Server system, the port in use, and the user name.

2. Use the `Add-EsxSoftwareDepot` command to add a software depot to Image Builder. Type the following command:

   NOTE

   vSphere PowerCLI commands are not case-sensitive.

   `PowerCLI C:\>` **`add-esxsoftwaredepot <software_depot_path>`**

   where <software_depot_path> is the software depot file path that you recorded in "Preparing for the lab."

3. Use the `Get-EsxImageProfile` command to verify that the image depot can be read. Type the following command:

   ```
   PowerCLI C:\> get-esximageprofile
   ```

   Two image profiles are listed: ESXi 5.1 (no tools) and ESXi 5.1 (standard) [VMware vSphere® ESXi™].

4. Use the `New-EsxImageProfile` command to create an image profile by cloning an existing profile. Type the following command on a single line:

   ```
   PowerCLI C:\> new-esximageprofile -cloneprofile <image_profile>
   -name myprofile -vendor myvendor
   ```

   where <image_profile> is the name of one of the profiles listed (your choice).

   NOTE

   When this step is complete, you can create your own custom image profile. You use the `Add-EsxSoftwarePackage` command to add VMware® installation bundles (VIBs) to the image profile. For this lab, you will not create a custom image profile.

5. Use the `Export-EsxImageProfile` command to export the image profile to an ISO image. Type the following command on a single line:

   ```
   PowerCLI C:\> export-esximageprofile -imageprofile myprofile
   -exporttoiso -filepath c:\depot\myprofile.iso
   ```

6. When the export is completed, verify that the file `myprofile.iso` exists in the `depot` directory. Type the following commands:

   ```
   PowerCLI C:\> cd \depot
   ```

   ```
   PowerCLI C:\> ls
   ```

7. Type **`exit`** to quit vSphere PowerCLI.

Lab 20

Configuring VMware vSphere Auto Deploy on a Windows vCenter Server System

Objective: Configure Auto Deploy to boot ESXi hosts

In this lab, you will perform the following tasks:

1. Install Auto Deploy.
2. Configure the DHCP server and TFTP server for Auto Deploy.
3. Use vSphere PowerCLI to configure Auto Deploy.
4. (For vClass users only) Configure the ESXi host to boot from the network.
5. (For non-vClass users) Configure the ESXi host to boot from the network.
6. View the autodeployed host in the vCenter Server inventory.
7. (Optional) Apply a host profile to the autodeployed host.
8. (Optional) Define a rule to apply the host profile to an autodeployed host when it boots.

Preparing for the lab

Record the following information:

Lab partner	
Team VMware® vCenter Server™ fully qualified domain name (FQDN)	
Team vCenter Server Administrator password	
Location of the VMware vCenter Installer	
Installation language	
DHCP/TFTP server name	
DHCP/TFTP server user name	
DHCP/TFTP server password	
Trivial File Transfer Protocol (TFTP) server root folder	
Management network address	
DHCP/TFTP server IP address	
File path to the VMware vSphere® ESXi™ offline image	

If you are working in a vClass environment, record the following information:

VMware® vCenter™ Lab Manager™ 4.0 URL	
Lab Manager user name	
Lab Manager password	
Lab Manager configuration name	
ESXi host root password	
Network adapter to boot from	

NOTE

In this lab, you will work with a lab partner, whose name you recorded in this section.

Task 1: Install Auto Deploy

In this task, you will install VMware vSphere® Auto Deploy™ on the vCenter Server system. Students should perform this task as a team. Student A should perform the steps in this task.

1. From your team vCenter Server desktop, go to the location of the VMware vCenter Installer, which you recorded in "Preparing for the lab." Double-click `autorun.exe`. The VMware vCenter Installer window is displayed.
2. Select **VMware vSphere Auto Deploy** and click **Install.**
3. When prompted by the installation wizard, perform the following actions.

Field/Setting	Action
Setup Language	Select the installation language that you recorded in "Preparing for the lab" and click **OK**. A warning message is displayed, stating that Windows Firewall cannot run because the Windows Firewall/Internet Connection Sharing (ICS) service is not running. Click **OK**.
Welcome Page	Click **Next**.
End-User Patent Agreement	Click **Next**.
License Agreement	Select **I accept the terms in the License Agreement** and click **Next**.
Destination Folder	Accept the defaults and click **Next**.
VMware vCenter Server Information	Enter the fully qualified domain name (FQDN) of the team vCenter Server system, user name Administrator, and the Administrator password. You recorded this information in "Preparing for the lab." Click **Next**.
vSphere Auto Deploy Port Settings	Accept the default port and click **Next**.
vSphere Auto Deploy Identification	Accept the default identification and click **Next**.
Ready to Install	Click **Install**.

4. Click **Finish** when the installation has completed.
5. Exit the VMware vCenter Installer.

Task 2: Configure the DHCP server and TFTP server for Auto Deploy

In this task, you will start the TFTP server on your DHCP/TFTP server. You will configure the DHCP server so that it can be used with Auto Deploy. Student B should perform the steps in this task.

1. Open a new Remote Desktop Connection and connect to your DHCP/TFTP server. You recorded the DHCP/TFTP server host name, user name, and password in "Preparing for the lab."
2. Start the TFTP server:
   a. Double-click the **TFTP Server** icon on the desktop.
   b. In the TFTP Server window, select **File** > **Configure**.
   c. Click **Start** to start the TFTP Server service.
   d. In the **TFTP Server Root Directory** field, verify that the TFTP server root folder matches the TFTP server root folder that you recorded in "Preparing for the lab."
   e. Click **OK**. In the main TFTP Server window, verify that the TFTP Server service started.
   f. Close the TFTP Server window.
3. From the DHCP/TFTP server desktop, open the VMware vSphere® Client™ and log in to the team vCenter Server system as user Administrator.
4. Select **Home** > **Administration** > **Auto Deploy**.
5. Click the **Download TFTP Boot Zip** link and save the file `deploy-tftp.zip` to the DHCP/TFTP server desktop.
6. Go to the DHCP/TFTP desktop. Right-click the file `deploy-tftp.zip` and select **Extract All**. Using the Extraction wizard, extract the files to the TFTP server root folder that you recorded in "Preparing for the lab." View the files in the TFTP server root folder.
7. Configure the DHCP server:
   a. From the DHCP/TFTP server desktop, click **Start** and select **Manage Your Server**. The Manage Your Server window is displayed.
   b. Near the bottom of the window, click the **Manage this DHCP server** link. The DHCP window is displayed.
   c. Expand the DHCP/TFTP server by clicking the plus sign (+) to the left of the DHCP/TFTP server name. A list of Scope folders is displayed.
   d. Expand the Scope folder that corresponds to your management network. You recorded the management network address in "Preparing for the lab."

e. Select **Scope Options** under the Scope folder that you expanded.

f. Right-click **Scope Options** and select **Configure Options.** The Scope Options dialog box is displayed.

g. Under **Available Options**, scroll down and select **066 Boot Server Host Name**. In the **String value** field, enter the IP address of the DHCP/TFTP server that you recorded in "Preparing for the lab."

h. Under **Available Options**, select **067 Bootfile Name**. In the **String value** field, type the name of the boot file:

```
undionly.kpxe.vmw-hardwired
```

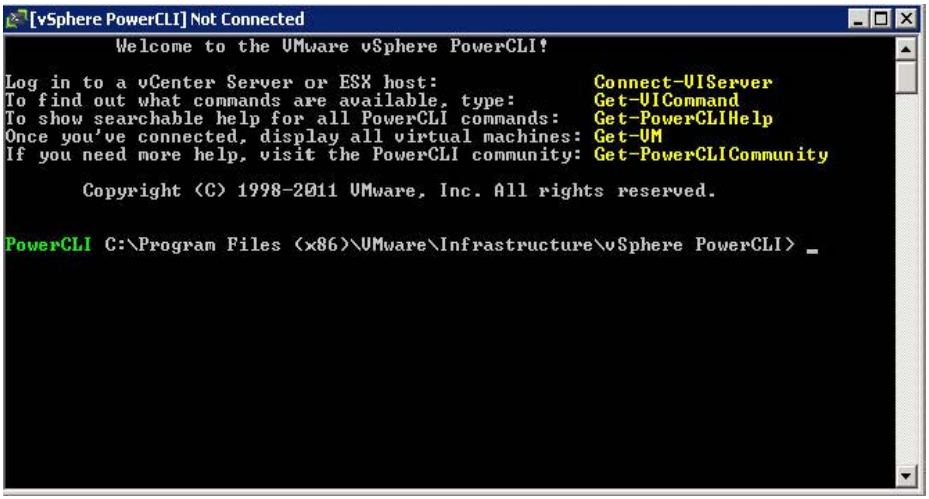
i. Click **OK.**

8. Minimize the DHCP/TFTP server remote desktop connection window.

Task 3: Use vSphere PowerCLI to configure Auto Deploy

In this task, you will use VMware vSphere® PowerCLI™ to configure Auto Deploy on the Windows vCenter Server system. You will create rules for the Auto Deploy rules engine. Student A should perform the steps in this task.

1. On the vCenter Server desktop, double-click the **VMware vSphere PowerCLI** icon. The vSphere PowerCLI window is displayed.



2. Use the `Get-ExecutionPolicy` command to verify that the execution policy is set to Unrestricted. Type the following command at the command prompt (>):

   `get-executionpolicy`

   NOTE

   vSphere PowerCLI commands are not case-sensitive.

   If the execution policy is not set to Unrestricted, use the `Set-ExecutionPolicy` command to set the execution policy. Type the following command:

   `set-executionpolicy unrestricted`

3. Use the `Connect-VIServer` command to connect to your vCenter Server system. Type the following command:

   `connect-viserver <team_vCenter_Server_system_FQDN>`

   where <team_vCenter_Server_systems_FQDN> is your team vCenter Server system's FQDN, which you recorded in "Preparing for the lab."

   If prompted, log in as user Administrator with the Administrator password that you recorded in "Preparing for the lab." The command returns a table that specifies the name or IP address of the vCenter Server system, the port in use, and the user name.

4. Use the `Add-ESXSoftwareDepot` command to load the software repository. Type the following command:

   `add-esxsoftwaredepot <path_to_the_ESXi_offline_image>`

   where <path_to_the_ESXi_offline_image> is the path that you recorded in "Preparing for the lab."

5. Use the `Get-EsxImageProfile` command to list the image profiles in the software repository. Type the following command:

   `get-esximageprofile`

   Two image profiles are listed: ESXi 5.1 (no tools) and ESXi 5.1 (standard).

6. Use the `New-DeployRule` command to create a rule named rule-imageprofile. This rule assigns an image profile to all hosts that are autodeployed. To create the rule, type the following command (on one line):

   `new-deployrule -name rule-imageprofile -item <image_profile_name> -allhosts`

   where <image_profile_name> is the name of the standard image profile that is displayed by the `Get-EsxImageProfile` command. The image profile name is case-sensitive. The option `-AllHosts` allows the new rule to be applied to all hosts that are autodeployed.

Sample command line (on one line):

```
new-deployrule -name rule-imageprofile -item ESXi-5.1.0-799733-standard
-allhosts
```

This command can take up to 5 minutes to run.

7. Create a rule named rule-cluster. This rule assigns an autodeployed host to a cluster. To create this rule, type the following command (on one line):

   `new-deployrule -name rule-cluster -item "Lab Cluster" -allhosts`

8. Use the `Add-DeployRule` command to add the new rule to the working rule set. Type the following command:

   `add-deployrule -deployrule rule-imageprofile`

   `add-deployrule -deployrule rule-cluster`

9. Use the `Get-DeployRuleSet` command to verify that the rules were created. Type the following command:

   `get-deployruleset`

10. Type **`exit`** to quit vSphere PowerCLI.

Task 4: (For vClass users only) Configure the ESXi host to boot from the network

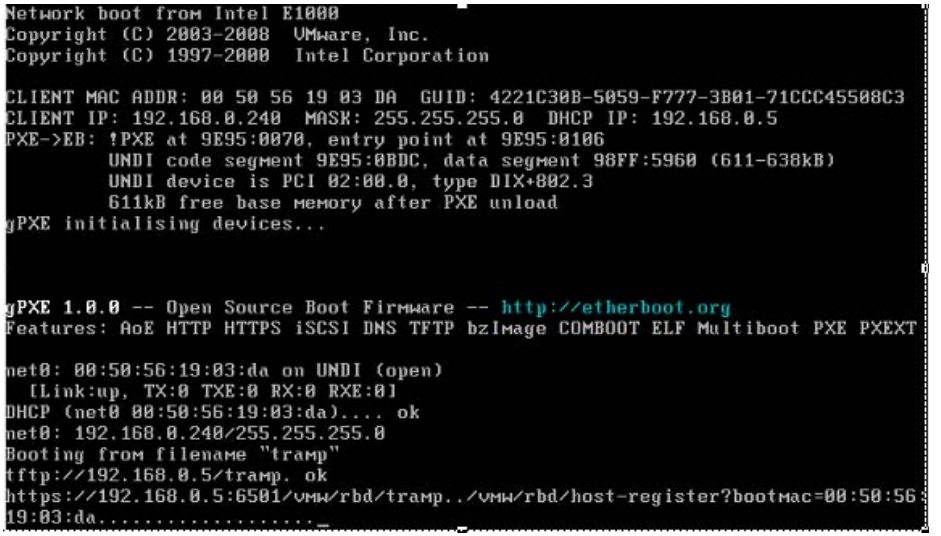
In this task, you will set up one ESXi host to boot from the network and verify that the ESXi host boots using Auto Deploy. Student B should perform the steps in this task.

CAUTION

The steps in this task are specific to the vClass lab environment. If you are using a vClass lab environment, perform this task. If you are not using a vClass environment, go to task 5. If you are unsure of the type of environment that you are using, ask your instructor.

1. Open a Web browser and enter the vCenter Lab Manager URL that you recorded in "Preparing for the lab." The Lab Manager login screen is displayed.
2. Log in to Lab Manager, using the Lab Manager user name and password that you recorded in "Preparing for the lab." The **Classes** >> **Overview** panel is displayed.
3. In the left pane, click the **Workspace** link. The **Configurations** panel is displayed.
4. In the **Configuration Name** column, click the link that corresponds to the Lab Manager configuration name that you recorded in "Preparing for the lab." The **Virtual Machines** tab is displayed.
5. In the **Console** column, click the screen icon that corresponds to your ESXi host. Your ESXi host console is displayed.

6. Click in the console and press F12. Pressing the F12 key enables you to restart the ESXi host.
7. Log in to your ESXi host as the root user with root's password, which you recorded in "Preparing for the lab."
8. Press F11 to restart the host.
9. Enter the BIOS by pressing F2 when the VMware® screen is displayed and before the host software starts to boot. The PhoenixBIOS Setup Utility is displayed.
10. In the setup utility, use the right arrow key to select the **Boot** menu. Using the down arrow key, select the network adapter to boot from. You recorded this information in "Preparing for the lab." Use the plus (+) key to move the network adapter to the top of the bootable devices list.
11. Use the right arrow key to select **Exit**. Select **Enter**. Select **Enter** again to save your changes and begin the boot process.
12. Verify that the ESXi host first gets an IP address from the DHCP server. Verify that the ESXI host performs a preboot execution environment (PXE) boot.



NOTE

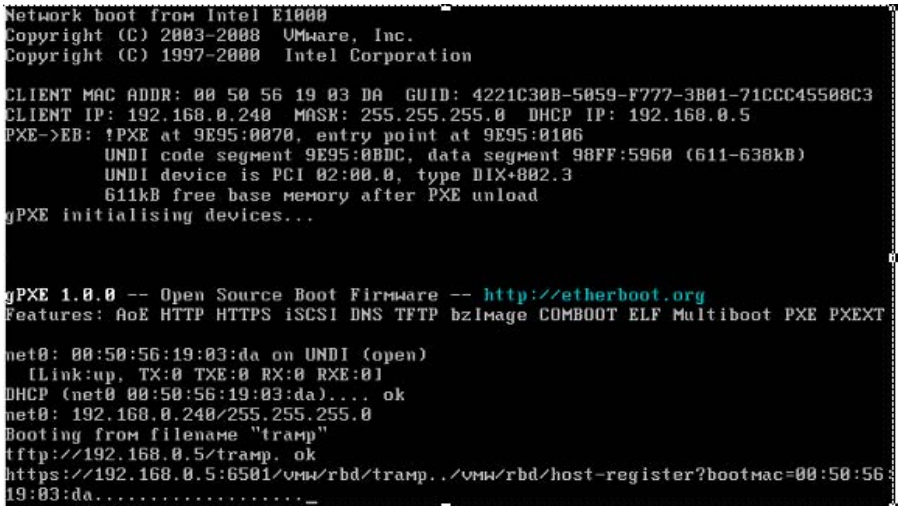
If during the boot process a TFTP timeout occurs, one possible reason is that the TFTP server is stopped. If the TFTP server is stopped, start it and try to boot the ESXi host again.

13. After the ESXi host has finished booting, verify that ESXi main console window displays the DHCP address.
14. Go to task 6.

Task 5: (For non-vClass users) Configure the ESXi host to boot from the network

In this task, you will set up your ESXi host to boot from the network and verify that your ESXi host boots using Auto Deploy. Student B should perform the steps in this task.

1. Reboot the ESXi host and enter the BIOS by pressing F2 when the VMware screen is displayed, before the host software starts to boot.
2. In the BIOS, use the arrow keys to select the **Boot** menu. Select the first network adapter and use the plus (+) key to move the network adapter to the top of the bootable devices list.
3. Select **Exit**. Select **Enter**. Select **Enter** again to save your changes and begin the boot process.
4. Verify that the ESXi host gets an IP address from the DHCP server. Verify that it performs a PXE boot.



NOTE

If during the boot process a TFTP timeout occurs, one possible reason is that the TFTP server is stopped. If the TFTP server is stopped, start it and try to boot the ESXi host again.

5. After the ESXi host has finished booting, verify that the ESXi console displays the DHCP address.

Task 6: View the autodeployed host in the vCenter Server inventory

In this task, you will verify that your autodeployed ESXi host is displayed in the vCenter Server inventory. Student A should perform the steps in this task.

1. If the vSphere Client is not already active, use the vSphere Client to log in to the team vCenter Server system.
2. After the autodeployed host has completed booting, verify that the host is added to the vCenter Server inventory. The host should be displayed in the Hosts and Clusters inventory view, under Lab Cluster.
3. Select the autodeployed host in the inventory and click the **Configuration** tab.
4. Click the **Storage** link and view the storage information.
5. Click the **Networking** link and view the network information. You do not see all of the storage and network devices that existed when this host was booted from disk. You can use host profiles to create the storage and network configuration on your autodeployed host.

Task 7: (Optional) Apply a host profile to the autodeployed host

In this task, you will apply a host profile to the autodeployed host. Student B should perform the steps in this task.

1. Verify that the second host is in the inventory. You will use the second ESXi host as the reference host for your host profile.
2. Create a host profile:
   a. Select **Home** > **Management** > **Host Profiles**.
   b. Click **Create Profile**.
   c. When prompted by the Create Profile wizard, perform the following actions.

Field/Setting	Action
Creation Method	Keep **Create Profile from existing host** selected and click **Next**.
Reference Host	Select your second (nonautodeployed) ESXi host and click **Next**.

Field/Setting	Action
Profile Details	In the **Name** field, type **`my_host_profile`**. Leave the **Description** field blank. Click **Next**.
Ready to complete the profile	Click **Finish**.

d. Verify that my_host_profile was created.

3. Apply my_host_profile to the autodeployed host:

   a. Go to the Hosts and Clusters inventory view (**Home** > **Inventory** > **Hosts and Clusters**) and place the autodeployed host in maintenance mode.

   b. Return to the Host Profiles page (**Home** > **Management** > **Host Profiles**).

   c. Select my_host_profile and click **Attach Host/Cluster**. The Attach Host/Cluster dialog box is displayed.

   d. In the left pane, select the autodeployed ESXi host and click **Attach**. The autodeployed host name should be displayed in the right pane. Click **OK**.

   e. Click the **Hosts and Clusters** tab. Select the autodeployed host and click the **Apply Profile** link.

      The host profile is applied to the autodeployed host. You might be prompted for user input during this operation. Work with your instructor to determine the correct values for each of the prompts because not all classroom lab environments have the same setup.

      After the profile is applied to the autodeployed host, a list of configuration tasks is displayed in the window.

   f. Click **Finish**.

   g. If compliance failures occur, discuss them with your instructor. For this lab exercise, it might be OK to ignore them.

4. Click the **Check Answer File** link. Verify that the **Answer File Status** column reads Complete.

5. Return to the Hosts and Clusters inventory view.

6. Select the autodeployed host and click the **Configuration** tab.

7. Click the **Storage** link and the **Networking** link. Verify that all your datastores and all your virtual switches are displayed.

Task 8: (Optional) Define a rule to apply the host profile to an autodeployed host when it boots

In this task, you will define a rule that assigns a host profile to the autodeployed host. You will test the rule by rebooting the autodeployed host. Student A should perform the steps in this task.

1. On the team vCenter Server desktop, double-click the **VMware vSphere PowerCLI** icon. The vSphere PowerCLI window is displayed.
2. Verify that the execution policy is set to Unrestricted:
   a. At the command prompt (>), type the following command:

      `get-executionpolicy`
3. Connect to your vCenter Server Appliance. Type the following command:

   `connect-viserver <team_vCenter_Server_system_FQDN>`

   where <team_vCenter_Server_system_FQDN> is the host name or IP address of the team vCenter Server system, which you recorded in "Preparing for the lab."

   If prompted, log in as vCenter Server user Administrator, with the Administrator password that you recorded in "Preparing for the lab."
4. Use the `New-DeployRule` command to create a rule named rule-hostprofile. This rule assigns a host profile to all hosts that are autodeployed. Type the following command (on one line):

   `new-deployrule -name rule-hostprofile -item my_host_profile -allhosts`
5. Use the `Add-DeployRule` command to add the new rule to the working rule set. Type the following command:

   `add-deployrule -deployrule rule-hostprofile`
6. Use the `Get-DeployRuleSet` to verify that the rule was created. Type the following command:

   `get-deployruleset`
7. Type **`exit`** to quit vSphere PowerCLI.
8. Verify that the rule works:
   a. From the vSphere Client, reboot the autodeployed host.
   b. After the autodeployed host has completed booting, select the autodeployed host in the inventory and click the **Configuration** tab.
   c. Click the **Storage** and **Network** links and verify that the storage and network configurations have been applied from the host profile.