MxGPU Setup Guide with VMware®

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1. Overview

This setup guide details the steps necessary to enable MxGPU on the AMD FirePro™ S7150 and S7150x2 family of products. The guide uses VMware® products as an example setup. These products include VMware ESXi™ as a hypervisor, the VMware vSphere® client and VMware Horizon® View™.

2. Hardware and Software Requirements

The sections below detail the hardware and software that are required for setting up the VMware environment.

2.1 Hardware Requirements

2.1.1 Host/Server

Graphics Adapter: AMD FirePro™ **S7150**, **S7150x2** for MxGPU and/or passthrough
***note that the AMD FirePro™ S7000, S9000 and S9050 can be used for passthrough only

Supported Server Platforms:

- Dell PowerEdge R730 Server
- HPE ProLiant DL380 Gen9 Server
- SuperMicro 1028GQ-TR Server

Additional Hardware Requirements:

- CPU: 2x4 and up
- System memory: 32GB & up; more guest VMs require more system memory
- Hard disk: 500G & up; more guest VMs require more HDD space
- Network adapter: 1000M & up

2.1.2 Client

Any of the following client devices can be used to access the virtual machine once these VMs are started on the host server:

- Zero client (up to 4 connectors) with standard mouse/keyboard and monitor
- Thin client with standard mouse/keyboard and monitor running Microsoft® Windows® Embedded OS
- Laptop/Desktop with standard mouse/keyboard and monitor running with Microsoft® Windows® 7 and up

2.2 Software Requirements

Product	Type	Install On	Section	Version/Download Location
VMware ESXi™	Hypervisor	Host (Server)	**3.1.1**	https://my.vmware.com/en/web/vmware/evalcenter?p=free-esxi6
VMware vSphere®	Client for Host	Host Admin. System	**3.2.2**	https://my.vmware.com/en/web/vmware/evalcenter?p=vsphere6
VMware Horizon® View™	Client Receiver	Client Terminal	**3.3.1**	http://www.vmware.com/products/horizon-view/horizon6-hol
Horizon® View™ Agent	Connection Broker	Virtual Machine	**3.2.4.4**	https://my.vmware.com/web/vmware/info?slug=desktop_end_user_computing/vmware_horizon_6/6_2
Horizon® View™ Agent Direct-Connection Plug-in	Plug-in	Virtual Machine		https://my.vmware.com/web/vmware/info?slug=desktop_end_user_computing/vmware_horizon_6/6_2
AMD FirePro™ VIB Driver	Hypervisor Driver	Host (Server)	**4.1**	http://www2.ati.com/drivers/firepro/amdgpuv-1.0.0-1oem.600.0.0.2494585.x86_64.zip
AMD VIB Install Utility	Script	Host (Server)	**4.1**	http://www2.ati.com/drivers/firepro/MxGPU-Setup-Script.zip
Windows Client OS	Guest OS	Virtual Machine		Windows 7 64 bit, Windows 8.1 64 bit
AMD FirePro™ Driver	Guest OS Graphics Driver	Virtual Machine	Error! eference source not found.	http://www2.ati.com/drivers/firepro/15.20.1041.1004-FirePro-Guest-Windowsx64-Retail.exe
PuTTY	SSH client	Host Admin. System		http://www.putty.org/
SSH Secure Shell	SSH Client and Download Utility	Host Admin. System	**3.2.1**	

Table 1 : Required Software for Document

(Links to non-AMD software provided as examples)

3. Test Environment Setup for VMware ESXi™

3.1 Host Server Setup

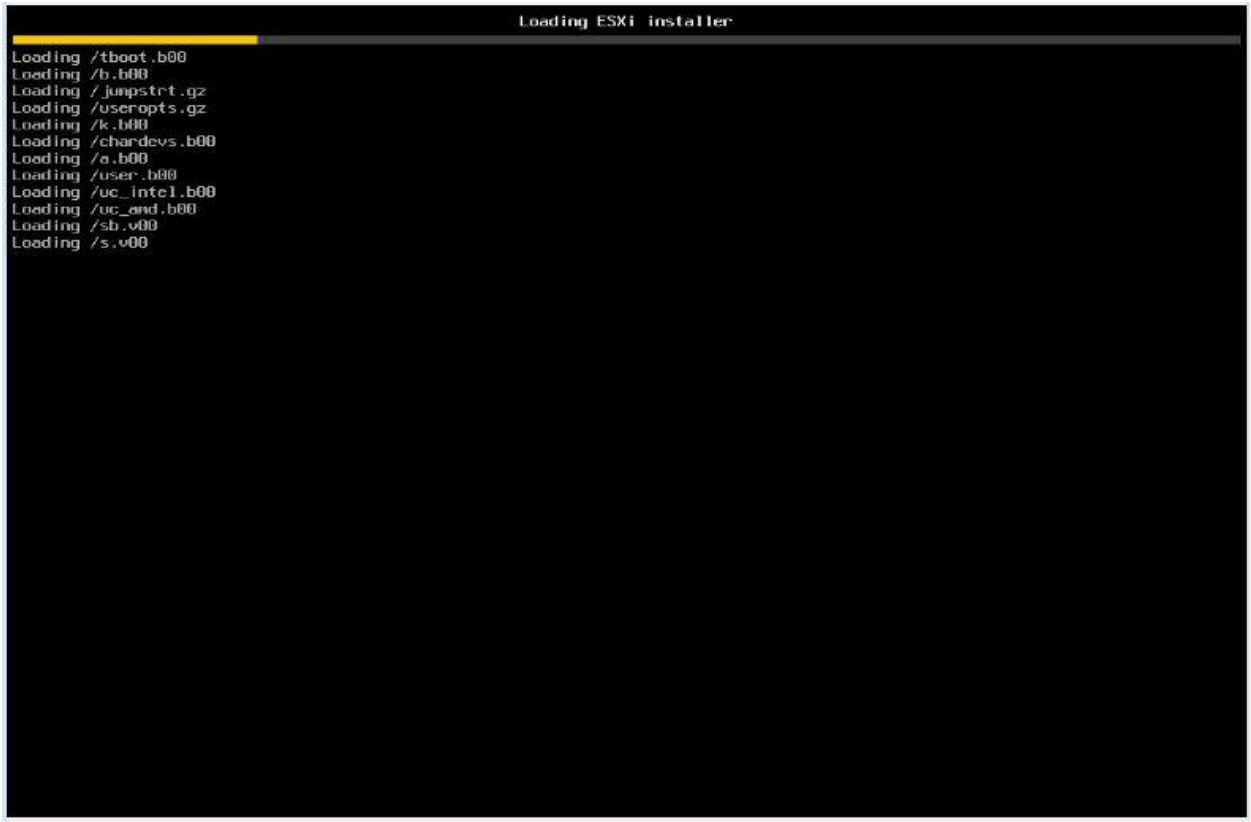
If ESXi is already installed on the host (server) then the steps in this section are not required.

3.1.1 Install ESXi on Host

If the VMware ESXi hypervisor is not yet installed on the host (server), then obtain a purchased copy of the software from the IT organization. Alternatively, trial versions of the hypervisor are available. The valid period of the trial licenses for ESX is 60 days.

1. Create a DVD ROM of the ESXi ISO after downloading the hypervisor from **Table 1**.

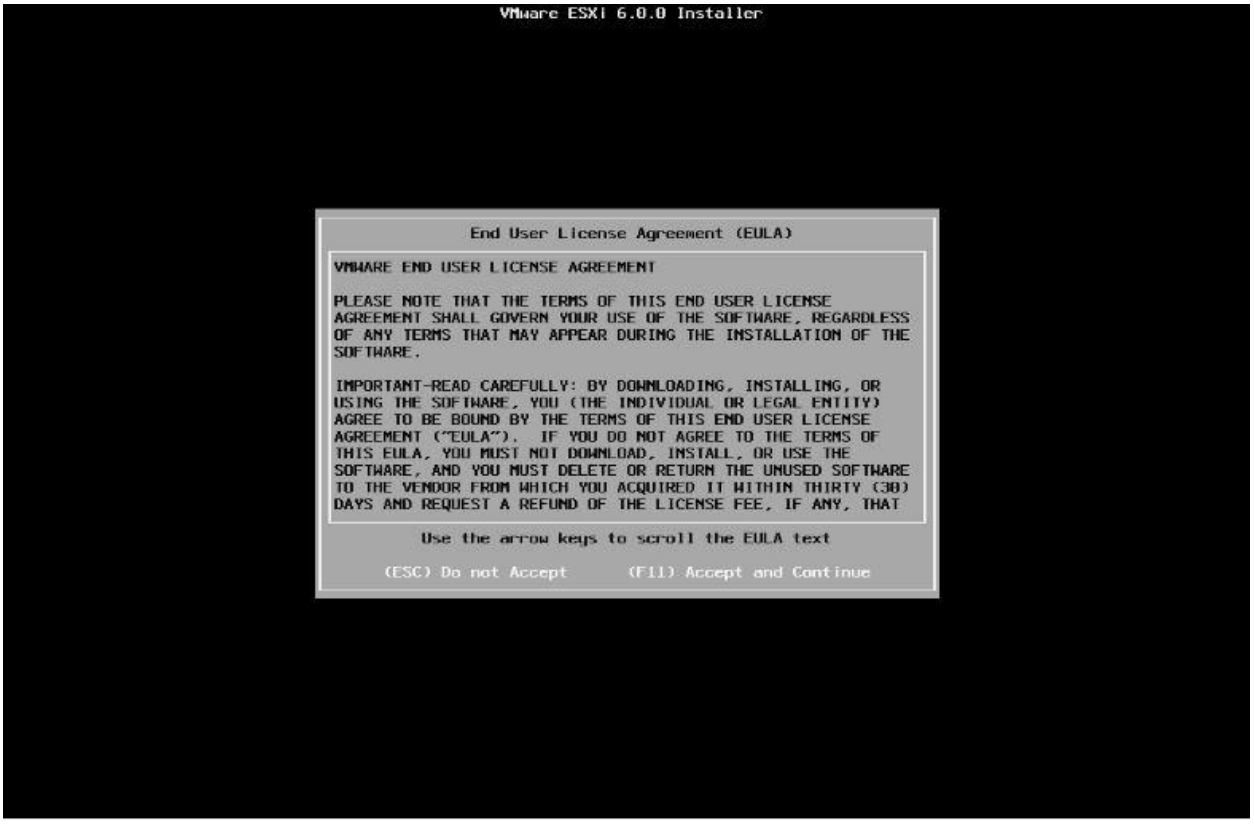
2. Connect a monitor to the host display, connect at least one of the network connectors (1000M Ethernet card is preferred) to the LAN, attach a USB DVD ROM to the server (or use the internal DVD ROM drive), set the DVD to be the first boot device. Next, place the DVD in the DVD ROM drive and reboot the server. After reboot, the installation starts with a screen similar to the following :

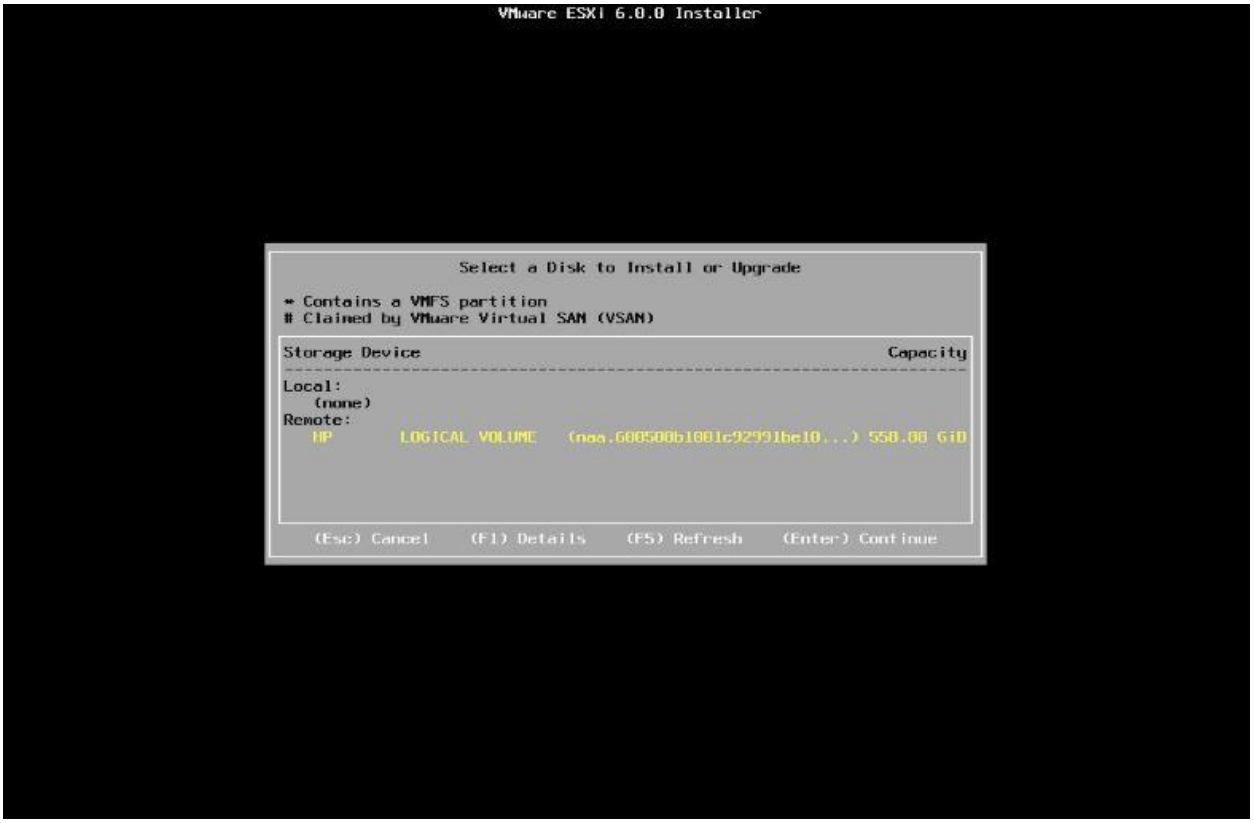


3. Before installing the hypervisor, the installation ISO loads drivers for common hardware devices detected in the host. Installation should proceed unless an unknown device (without drivers) is detected.

4. Once all required services and drivers are loaded, the welcome screen appears and prompts for confirmation before installing ESXi.

5. Follow the instructions shown on the monitor, and choose the default settings when prompted.




VMware ESXi 6.0.0 Installer
Select a Disk to Install or Upgrade
* Contains a VMFS partition
# Claimed by VMware Virtual SAN (VSAN)
Storage Device
Capacity
Local:
(none)
Remote:
HP LOGICAL VOLUME (naa.600508b1001c92991be10...) 558.00 GiB
(Esc) Cancel
(F1) Details
(F5) Refresh
(Enter) Continue

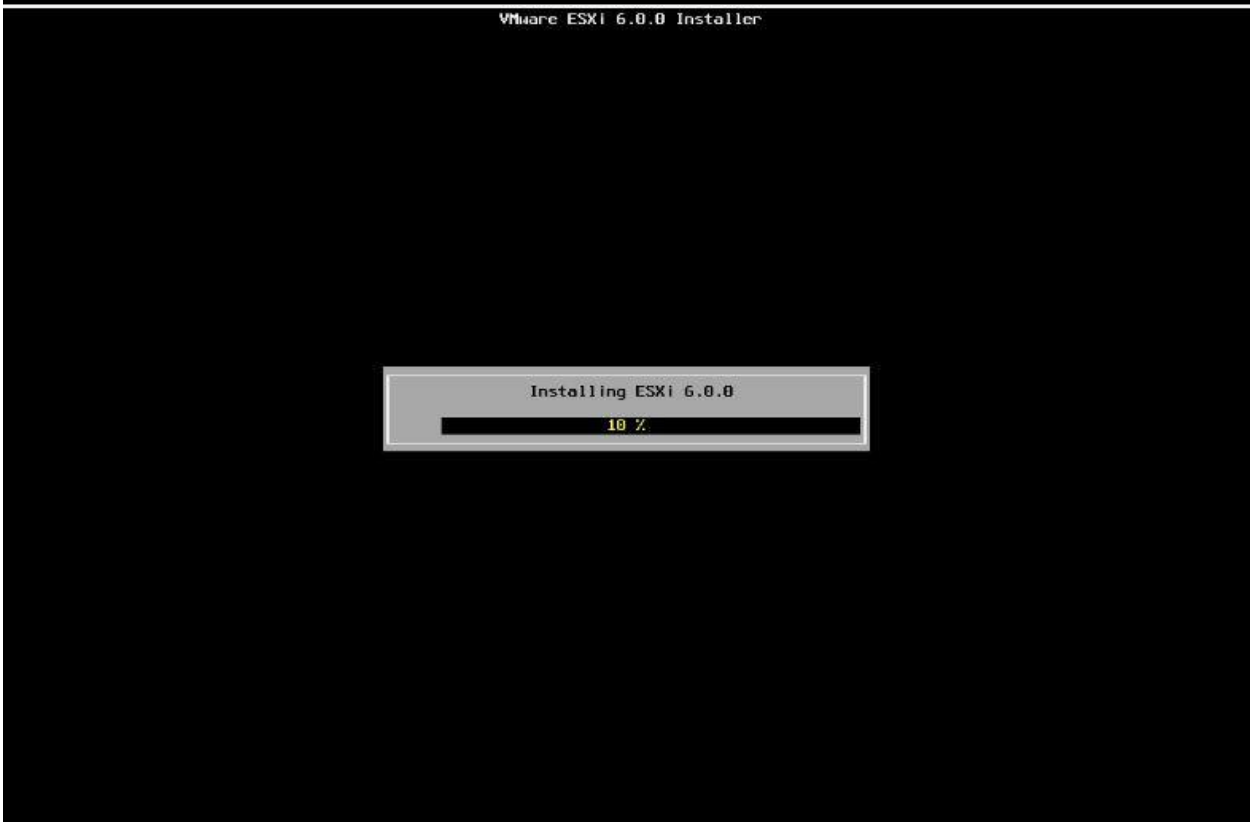
VMware ESXi 6.0.0 Installer
Select a Disk to Install or Upgrade
ESXi Found
The selected storage device contains an upgradable installation of ESXi. Choose whether to install or to upgrade ESXi.
(X) Install
( ) Upgrade
Use the arrow keys and spacebar to select an option.
(Esc) Cancel
(Enter) OK
(Esc) Cancel
(F1) Details
(F5) Refresh
(Enter) Continue

VMware ESXi 6.0.0 Installer
Please select a keyboard layout
Swiss French
Swiss German
Turkish
US Default
US Dvorak
Ukrainian
United Kingdom
Use the arrow keys to scroll.
(Esc) Cancel
(F9) Back
(Enter) Continue

6. When prompted, create a **root password** and take note of this password.

7. Depending on the current state of the host, additional screens may appear.

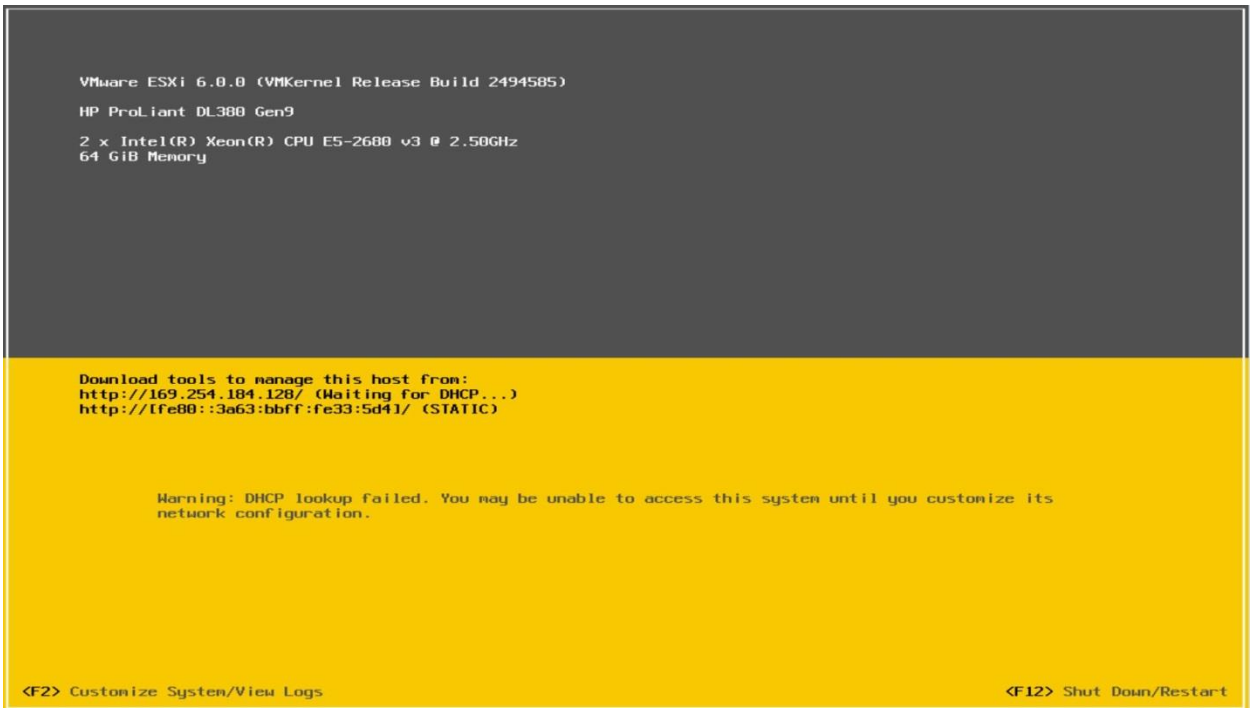
8. A final confirmation prompt appears. Select “F11”.



9. Select “Enter” to reboot the host after installation completes.

3.1.2 Configuring the ESX® Host

After reboot, the following screen appears:

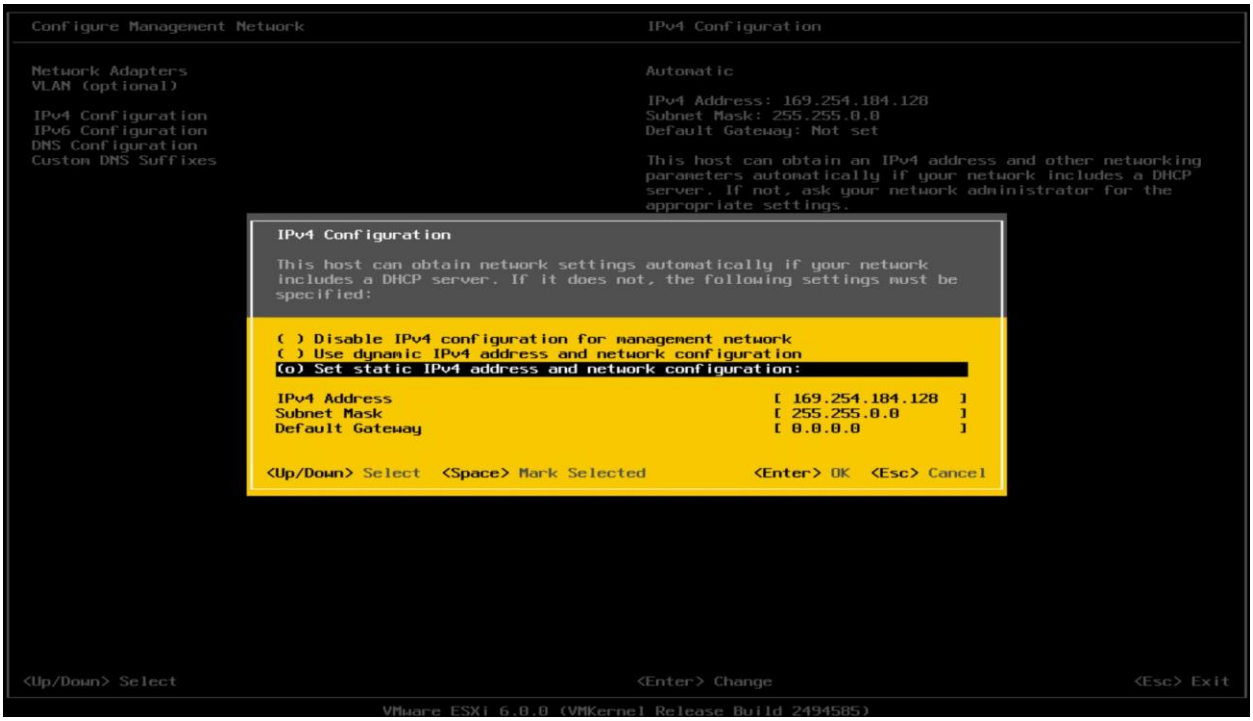


1. Select the “F2” button (“**Customize System/View Logs**”)
2. After entering the **root password** chosen during installation, select “**Troubleshooting Options**”, then select “**Enable ESXi Shell**” and “**Enable SSH**”

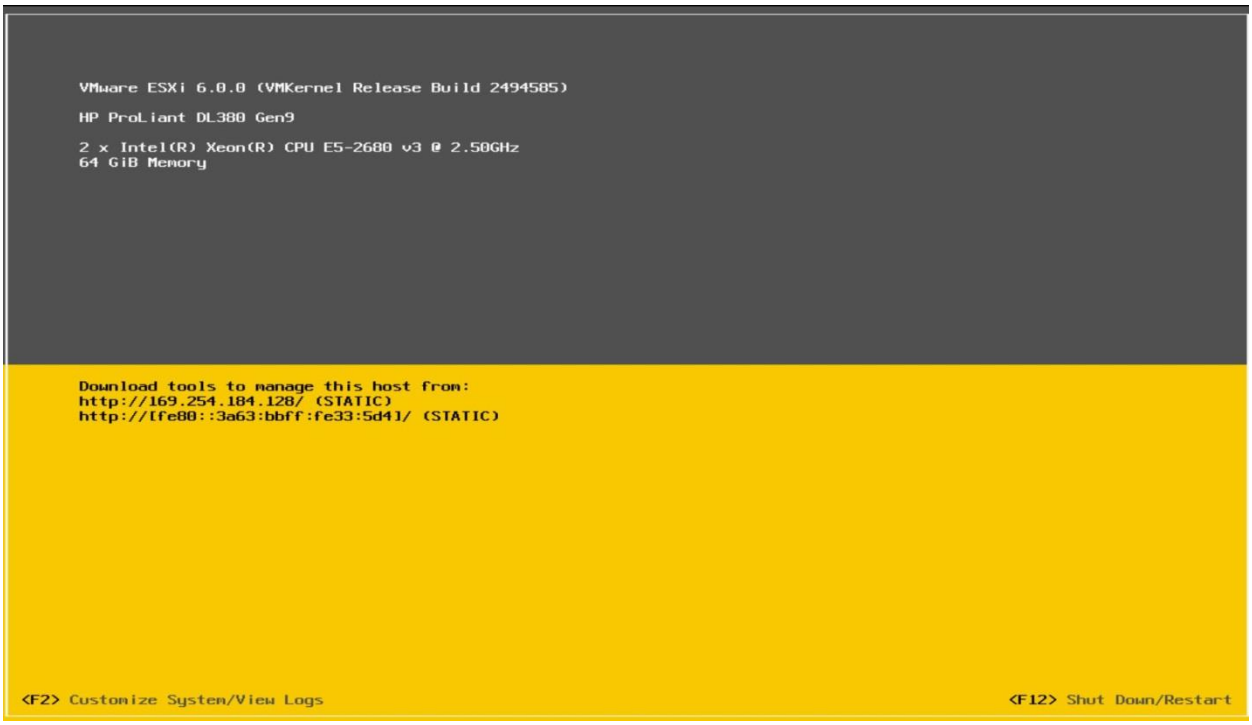
System Customization
Configure Password
Configure Lockdown Mode
Configure Management Network
Restart Management Network
Test Management Network
Network Restore Options
Configure Keyboard
Troubleshooting Options
View System Logs
View Support Information
Reset System Configuration
Troubleshooting Options
To view various troubleshooting mode options like Enable ESXi Shell, Enable SSH and Restart Agents.
<Enter> More
<Esc> Log Out
VMware ESXi 6.0.0 (VMkernel Release Build 2494585)

Troubleshooting Mode Options
Enable ESXi Shell
Enable SSH
Modify ESXi Shell and SSH timeouts
Modify DCUI idle timeout
Restart Management Agents
SSH Support
SSH is Disabled
Change current state of SSH
<Up/Down> Select
<Enter> Change
<Esc> Exit
VMware ESXi 6.0.0 (VMkernel Release Build 2494585)

3. Choose “Configure Management Network” and select “IPv4 Configuration”. Use the “static” address.



4. Save the IP address shown below to access host through either SSH or vSphere client later.

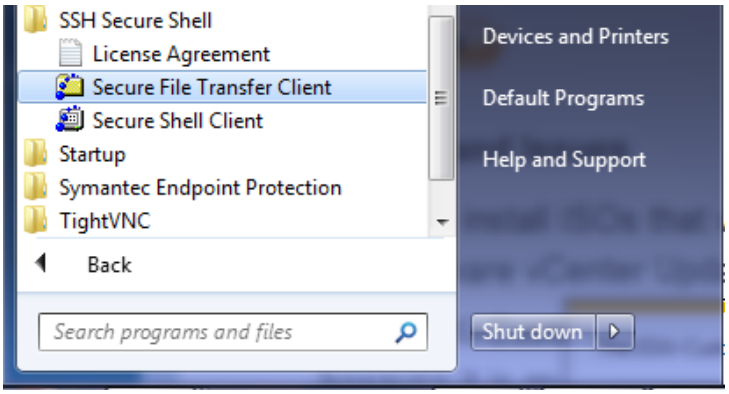


3.2 Host Administrator System Setup

3.2.1 Install SSH Secure Shell

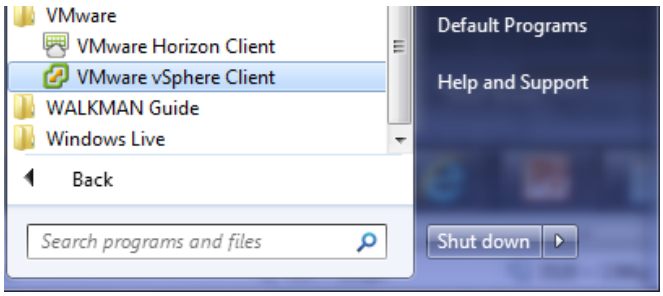
SSH Secure Shell will be needed for future updates and installations. This section assumes that SSH has already been enabled on the host (see previous section).

1. On the administrator system, download SSH Secure Shell from **Table 1**.
2. Run this application.
3. After installation, two utilities will be installed as Secure Shell Client & Secure File Transfer Client as the following :

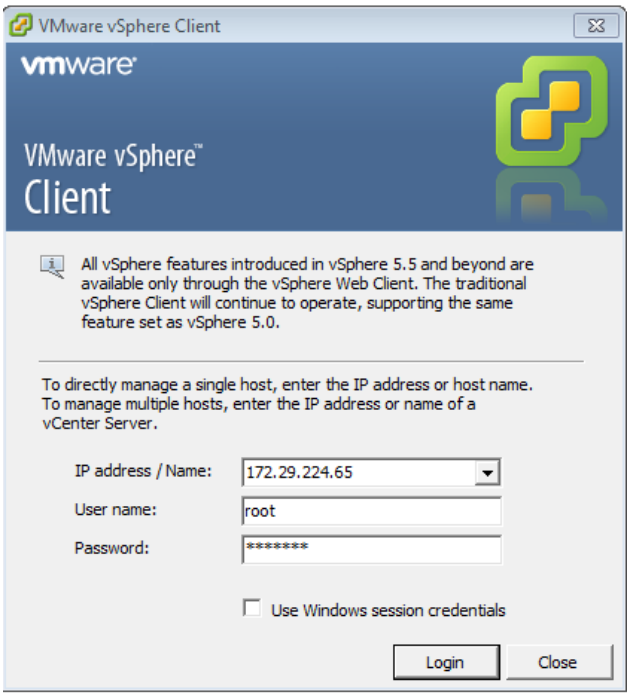


3.2.2 Install vSphere Client 6.0.0

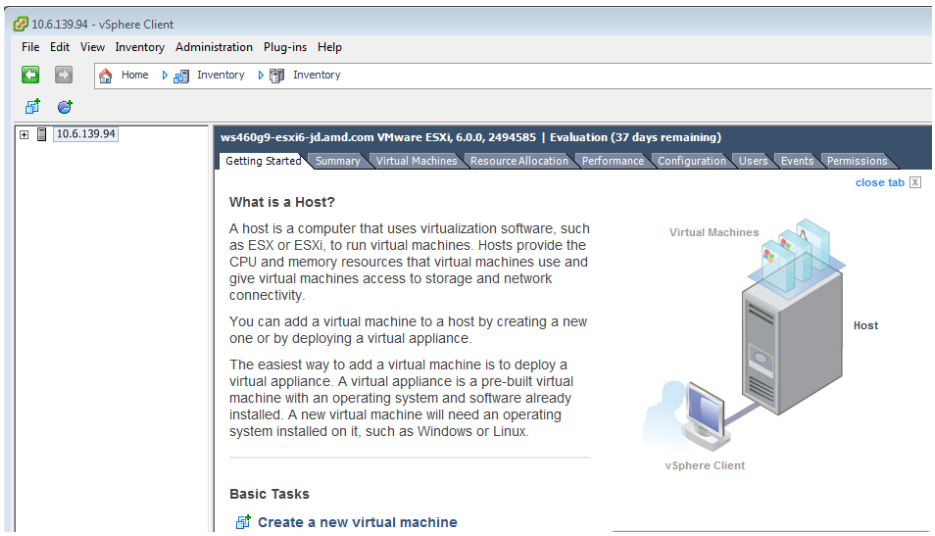
1. On the administrator system, download the vSphere client from **Table 1**.
2. Run this application: VMware-Setup.exe
3. After installation, the VMware vSphere client will be installed as



4. Start this application. Ensure that the ESXi host server is up and running. Enter the ESXi host IP address (as noted previously) or computer name in “IP address / Name” entry field. Type “root” in “User Name” entry field. Enter the password created while setting up ESXi in the host server. Click Login button to connect to host.



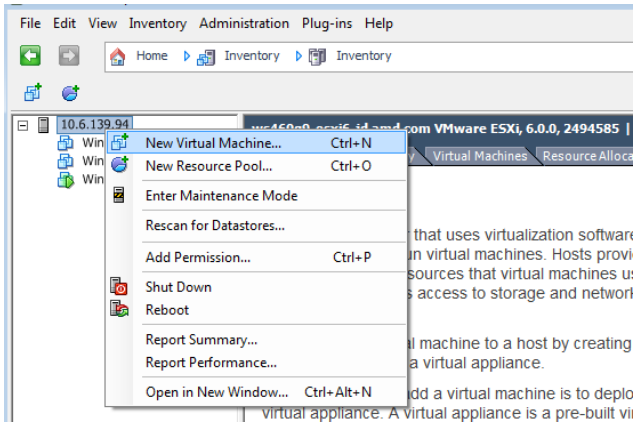
5. Once connected to the host, the vSphere client application displays a similar window to this :



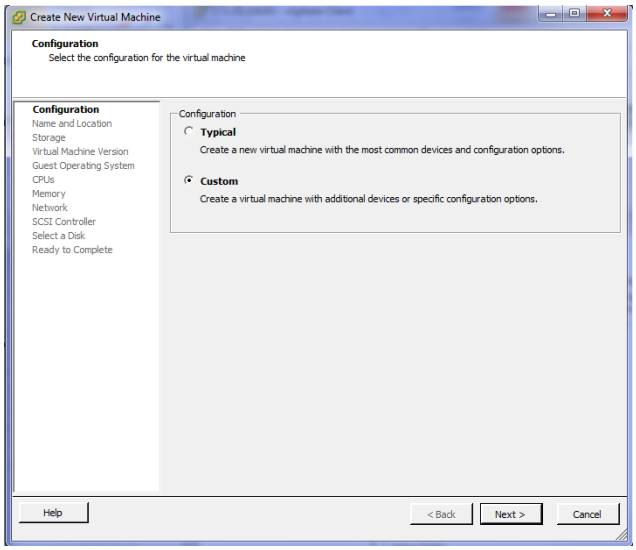
Note: A server name is shown rather than the host IP address

3.2.3 Create a Guest Virtual Machine

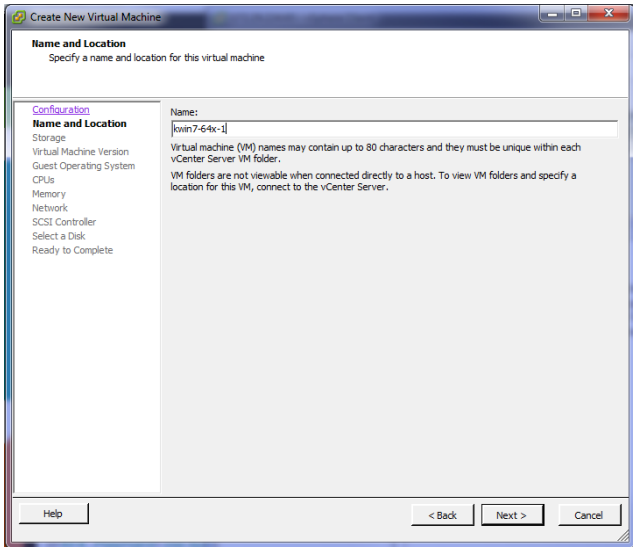
1. On vSphere client window, right click on the host name (in this example, the IP address). Select “New Virtual Machine”.



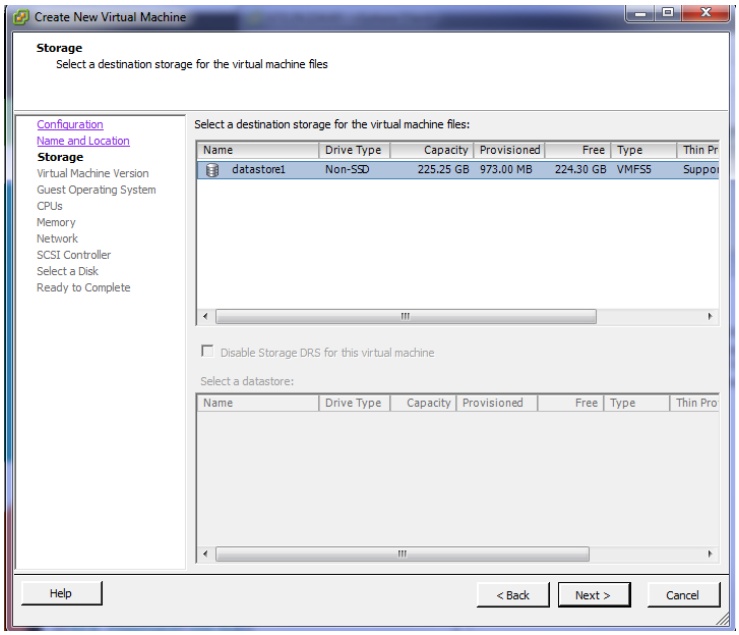
2. In the next window, select Custom and click on Next



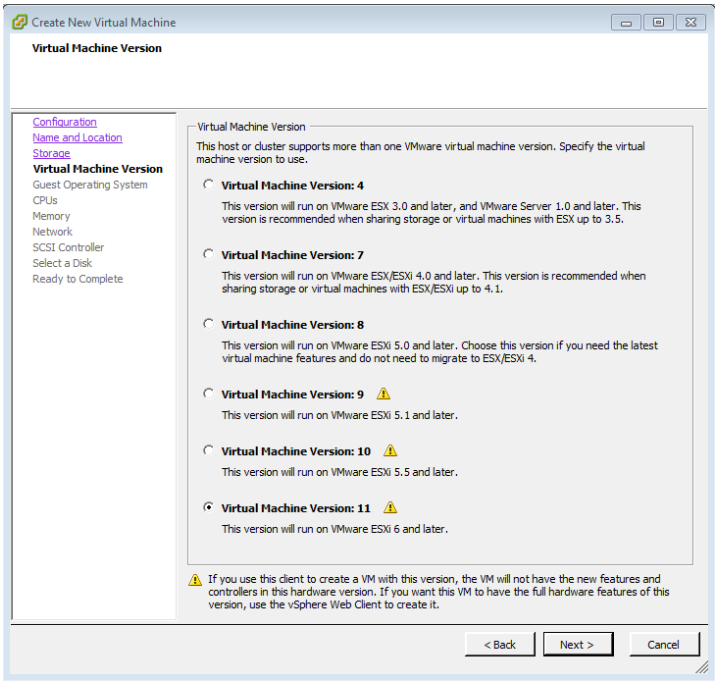
3. Click on Next and enter a name for the virtual machine, e.g. kv6-win7-64x-1



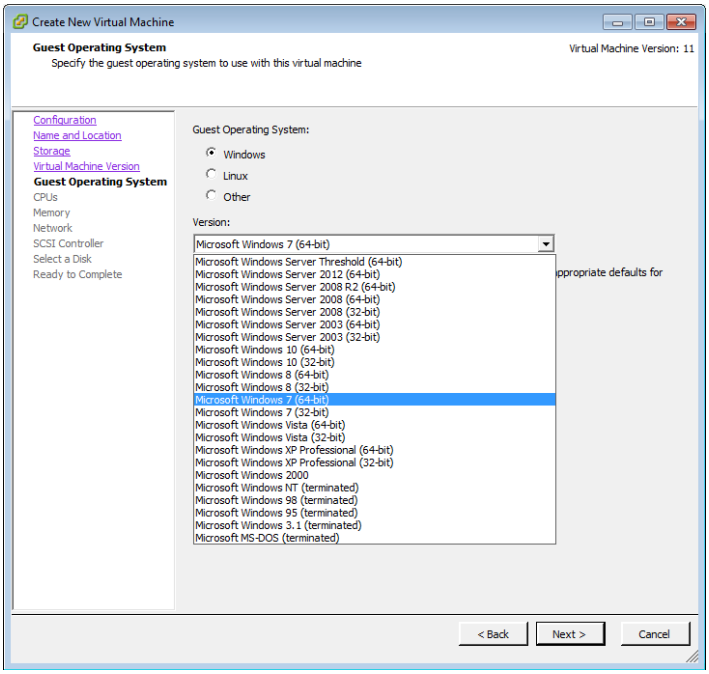
4. Click on Next and select the storage destination for the virtual machine. If there is only one hard disk on the server then, by default, it will be named, **datastore1**. If there are multiple hard disks on the server, there will be multiple destinations named, **datastore<#>**. Select the disk desired for the location of the virtual machine.



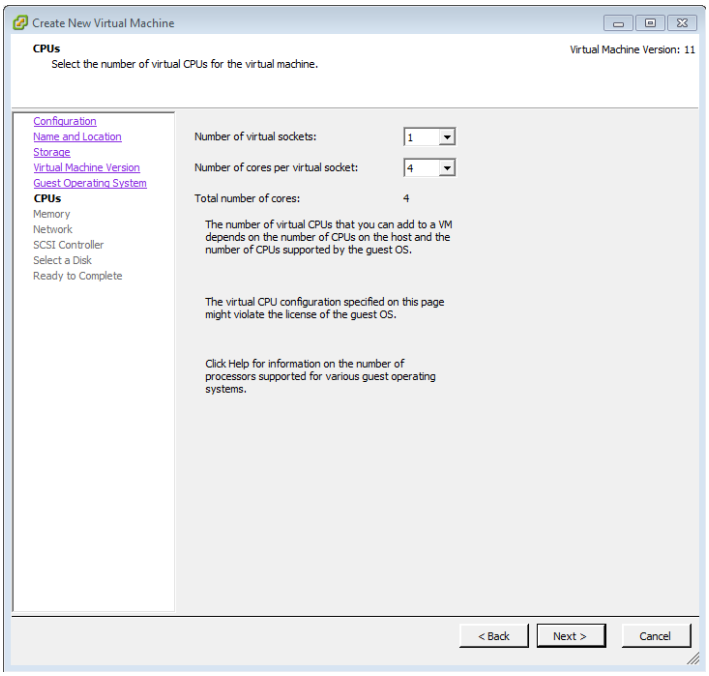
5. Click on Next and select “ESXi 6.0 and later”. With this option, the virtual machine will be set to VM version 11.



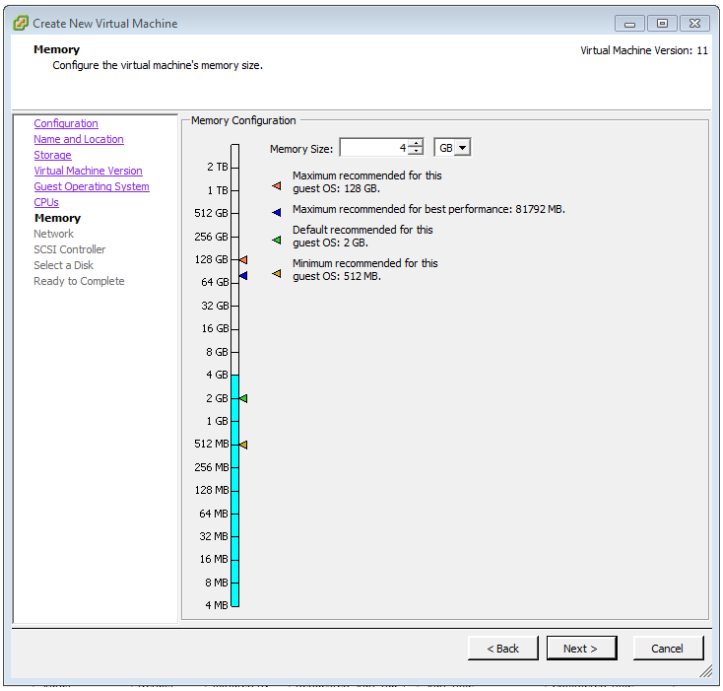
6. Click on Next and select the guest OS version which will be installed on this virtual machine. In this example, Microsoft Windows 7 (64-bit) is selected.



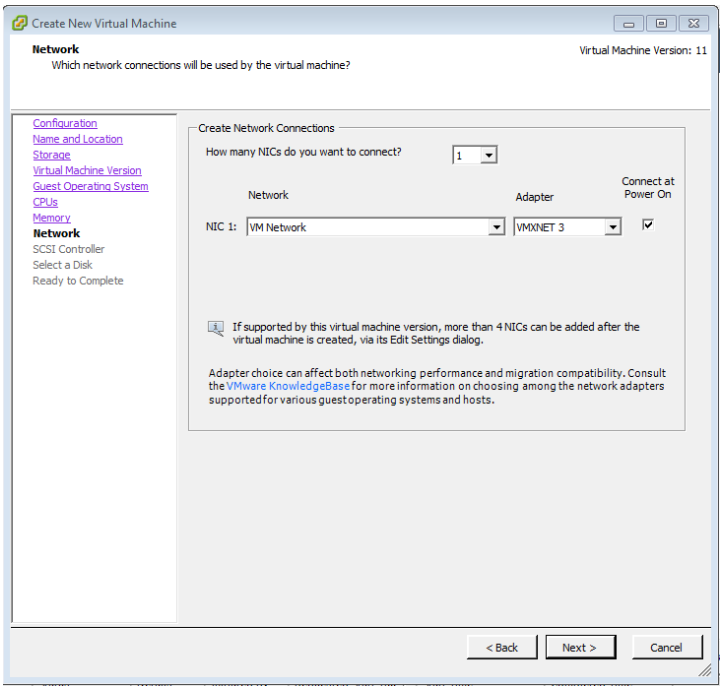
7. Click on Next and enter the number of virtual CPU cores, system memory size, and hard disk size for this virtual machine; leave all the other options at default.



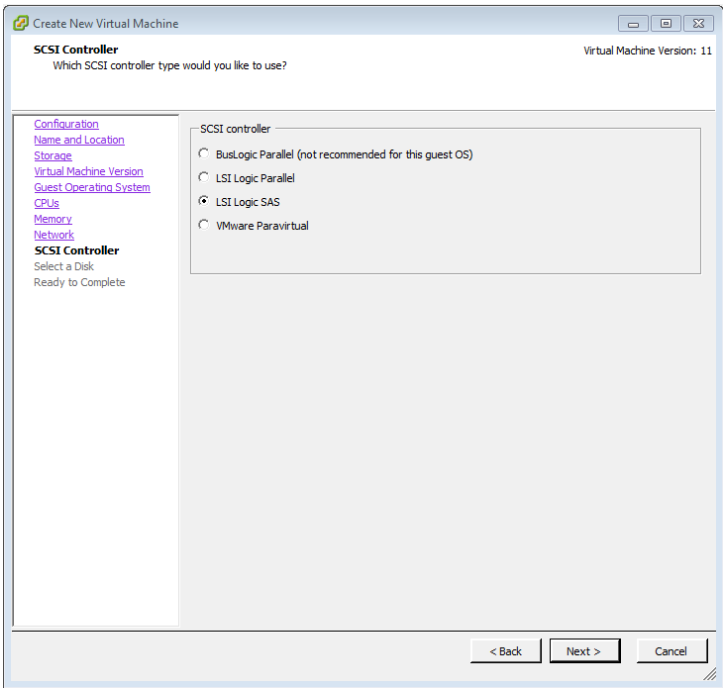
8. Click on Next and select the system memory size for this virtual machine.



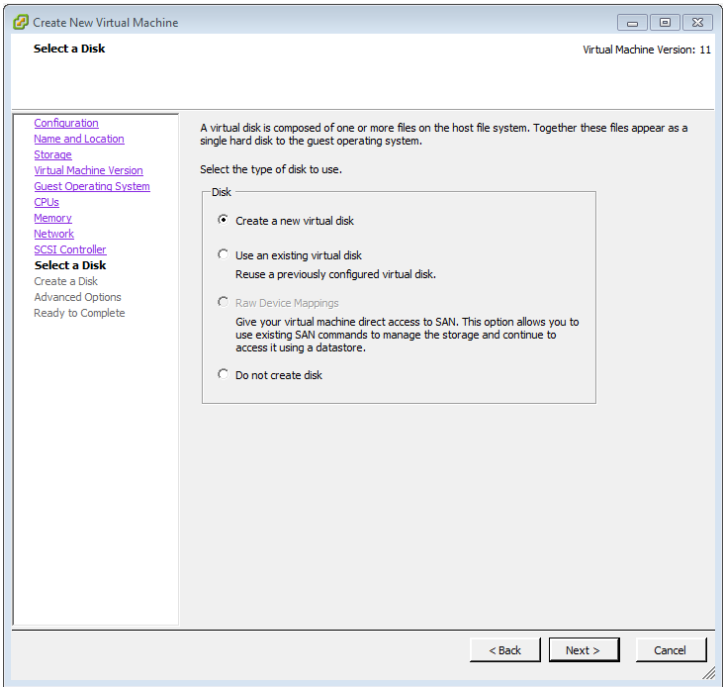
9. Click on Next and select the network connection for this virtual machine. Choose “VMXNET 3”.



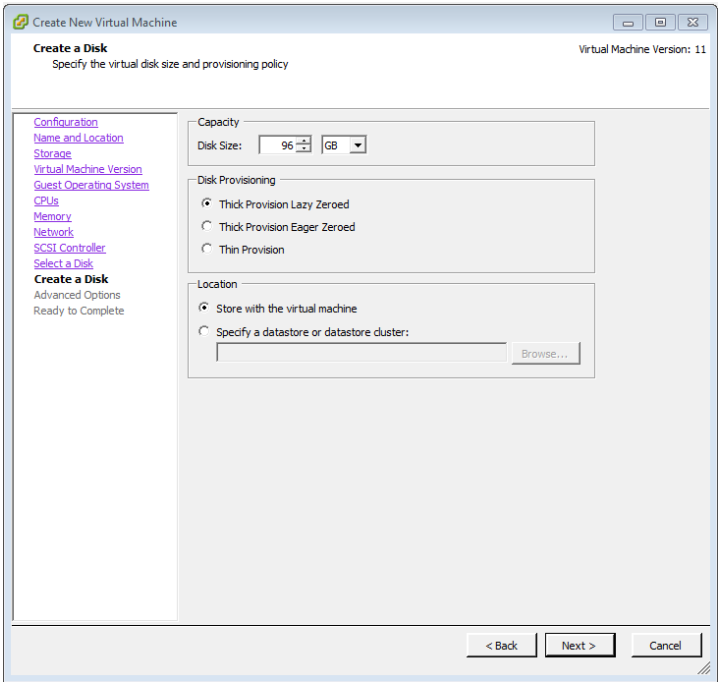
10. Click on Next and select the SCSI controller for this virtual machine. Choose the default setting.



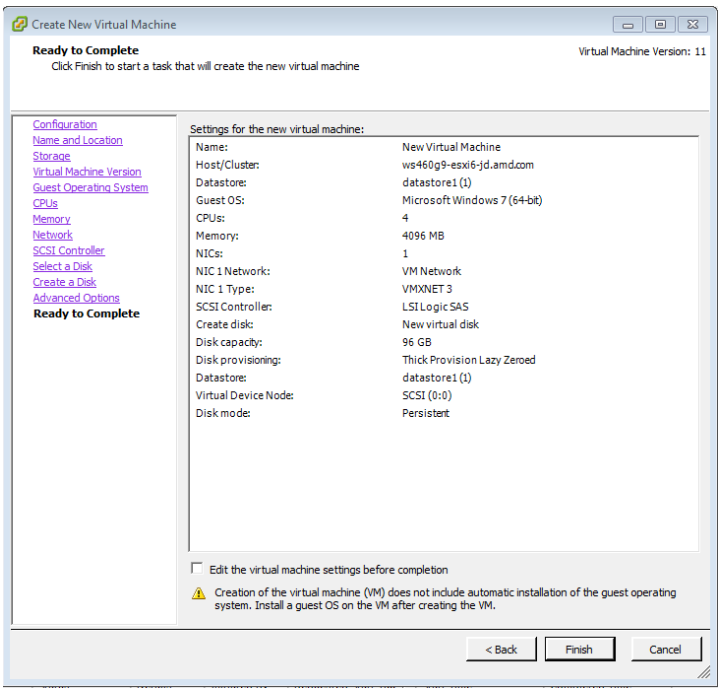
11. Click on Next, select a virtual disk to use. Select create a new virtual disk.



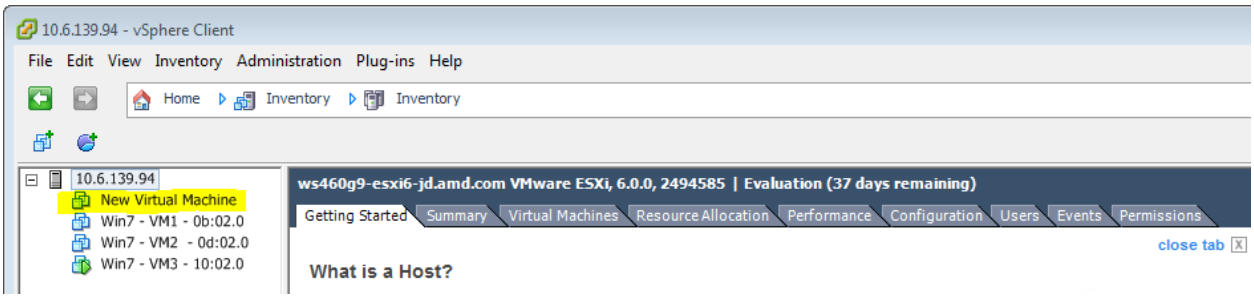
12. Click on Next and select disk size, provision, and location. The recommend minimum disk size is 96GB. For “Disk Provisioning”, select “Thick Provision Lazy Zeroed”. For “Location”, select “Store with the virtual machine”



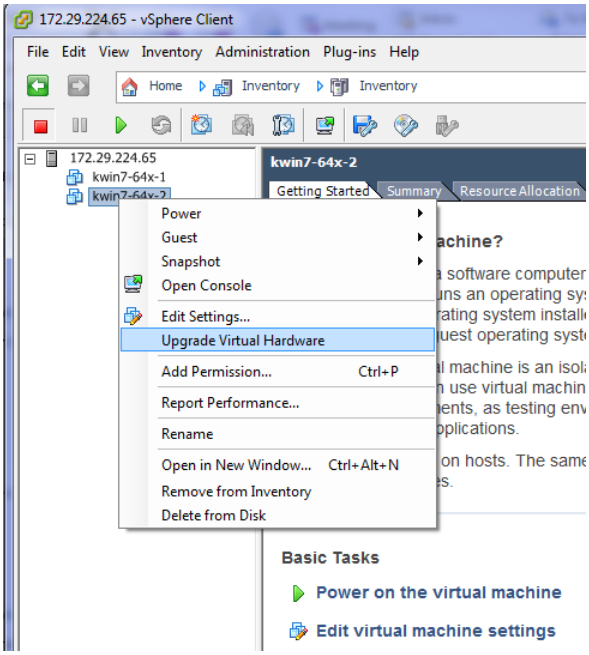
13. Click on Next. An “Advanced Options” page will appear. Don’t change anything, just click on Next. A Ready to complete windows will shows the summary of the virtual machine will be created.



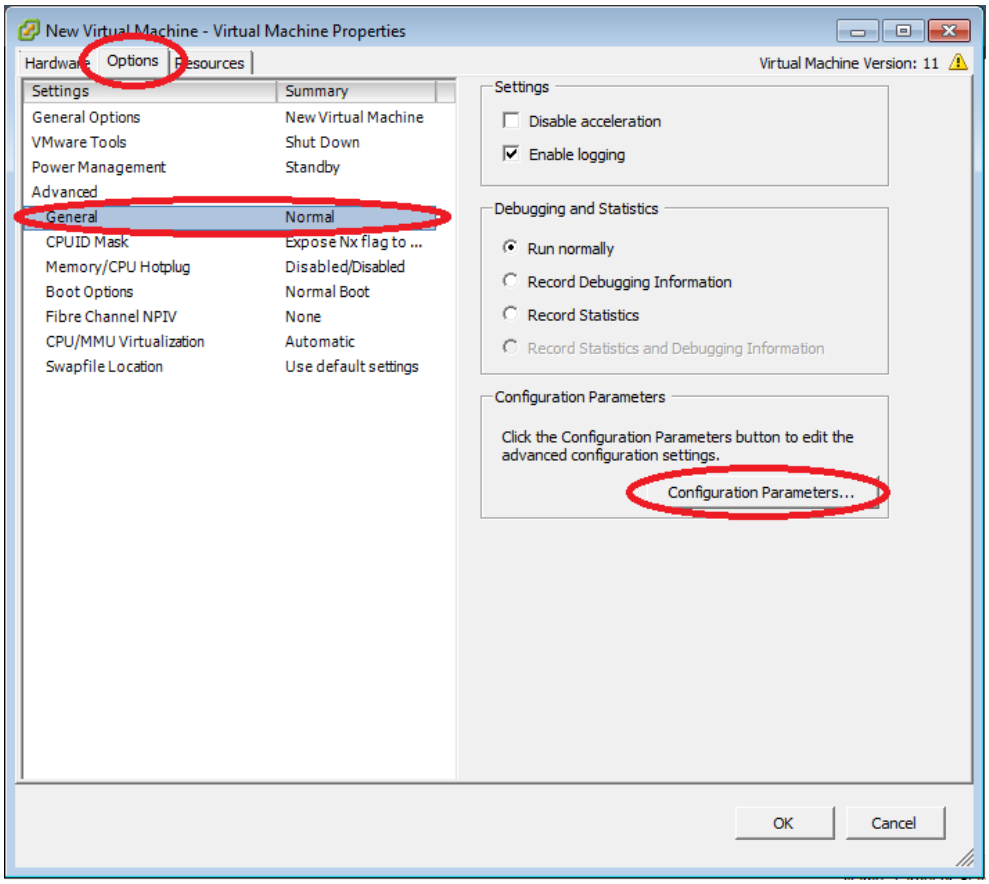
14. After clicking on “Finish”, a new virtual machine will appear under the host IP address as the following :



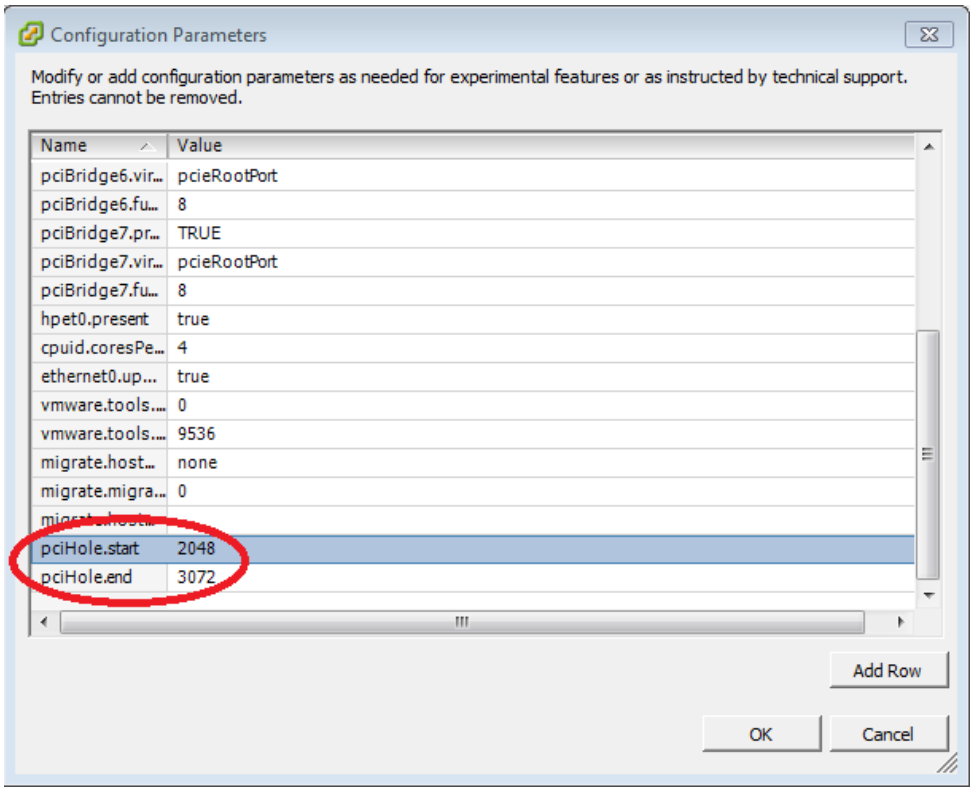
15. If VMs have not been updated to the latest VM type, right click on the virtual machine and select “Upgrade Virtual Hardware”. If a warning window pops up indicating that the virtual machine will upgrade to version 11, click “Yes” and continue.



16. Right click on this virtual machine again and select “Edit Settings…”. A warning window will pop up indicating that advanced settings can be changed only within VMware vCenter™. Click OK to continue. The “Virtual Machine Properties” window appears. Within the properties windows, click the “Options” tab and select “General” under the “Advanced” section. On the right side, a “Configuration Parameters…” button will appear. Click on this button.



17. In the “Configuration Parameters” window, scroll through to find the parameters named “pciHole.start” and “pciHole.end”. If these two parameters exist, ensure that the values are set to 2048 and 3072, respectively. If these two parameters do not exist, click the button “Add Row”, and add “pciHole.start” and “pciHole.end” with the above values. Next, click OK to return to main control page of vSphere client.



The virtual machine is now ready for guest OS installation.

3.2.4 Install Guest OS on Guest VM

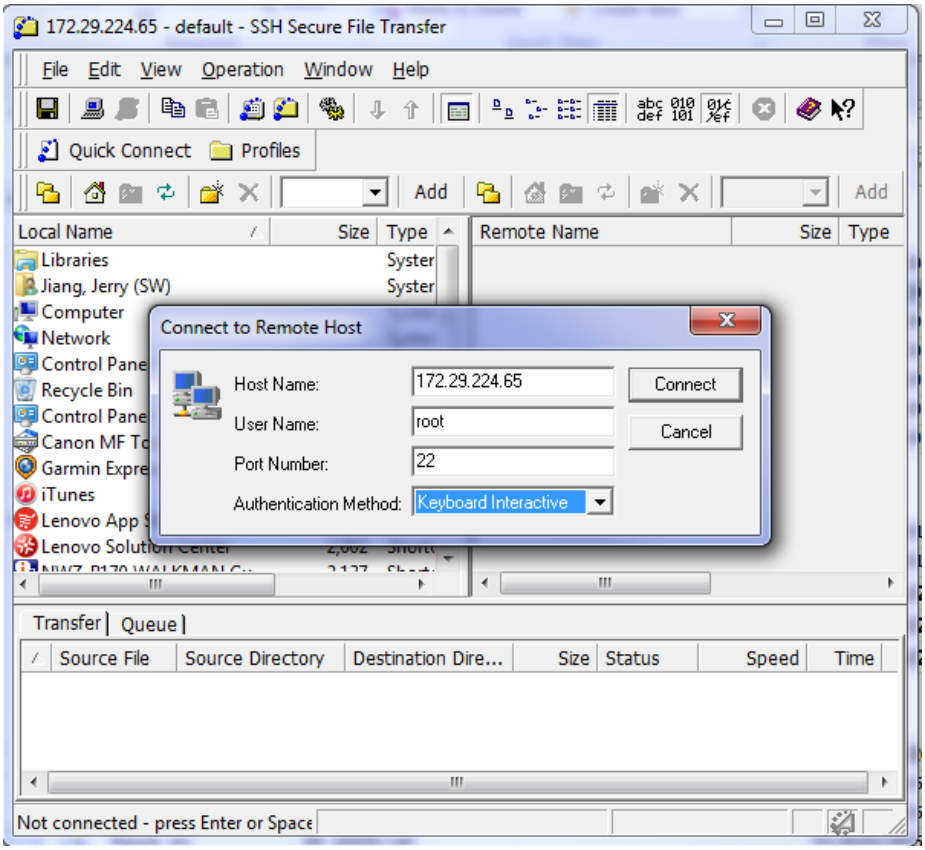
There are several ways to install a guest OS on this newly created virtual machine:

1) Install a fresh OS using ISO image on the administrator system
2) Install a fresh OS using ISO image on ESXi data storage
3) Clone an OS image created and used previously

Methods 1 and 2 are similar. Method 2 will be used as an example.

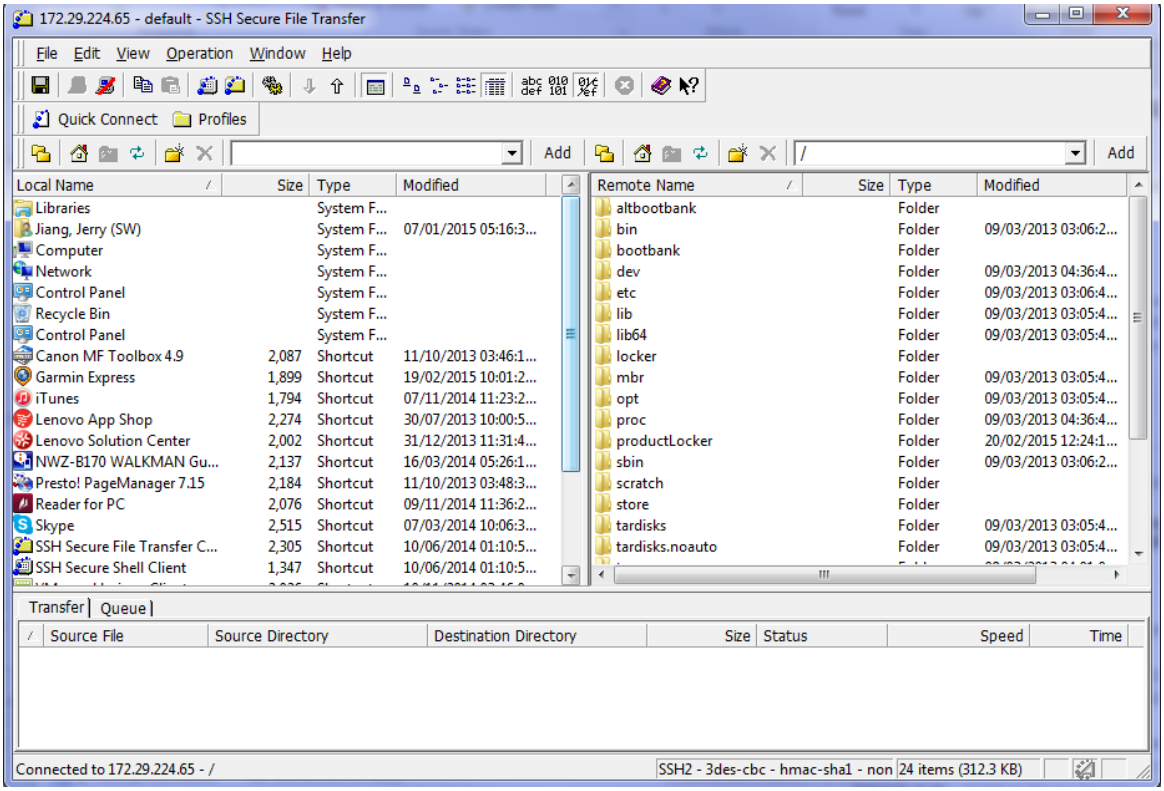
3.2.4.1 Upload file to host ESXi

1. Start the SSH Secure File Transfer utility and click on “Quick Connect”. The application will pop up a window like the following :

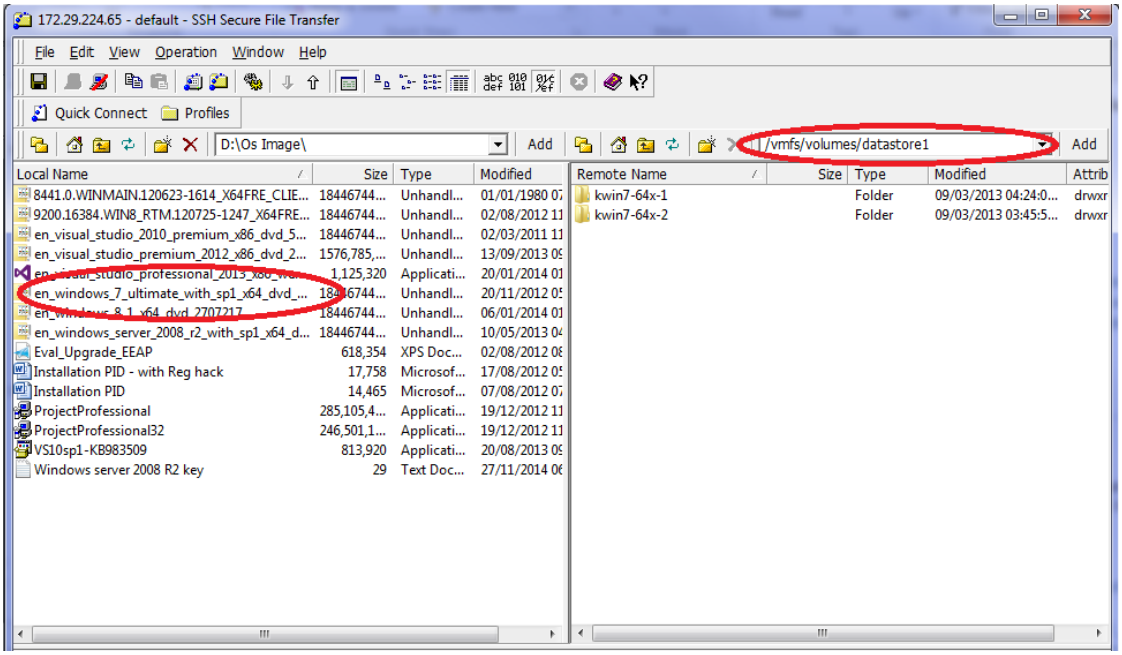


2. Enter the ESXi host IP address or computer name in “Host Name”; type “root” in “User Name”; select “Keyboard interactive” from “Authentication Method”. Click on the Connect button to connect to host.

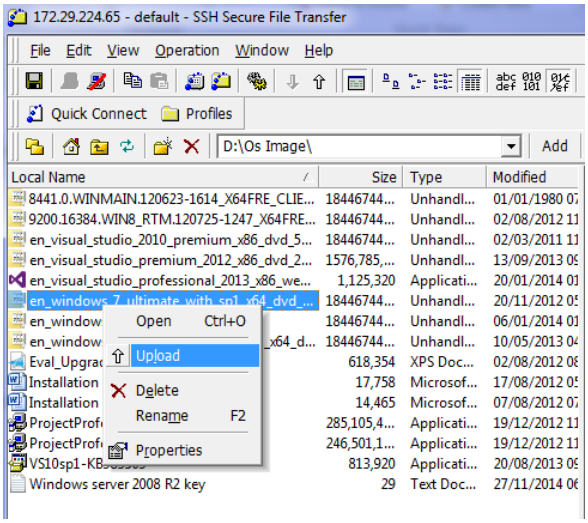
3. Enter the password created while setting up ESXi in the host server. Once connected to the host, the application should have the following windows :



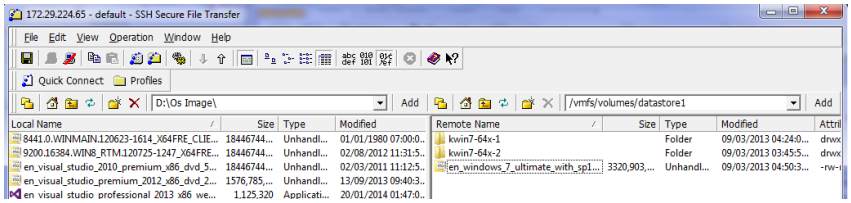
4. The left is the administrator system, the right is the host ESXi system. On the left window, navigate to the location where the OS ISO image is stored; on the right window, navigate to **/vmfs/volumes/datastore1**.



5. Right click on the desired OS image/file and select the "Upload" after right clicking on the file.



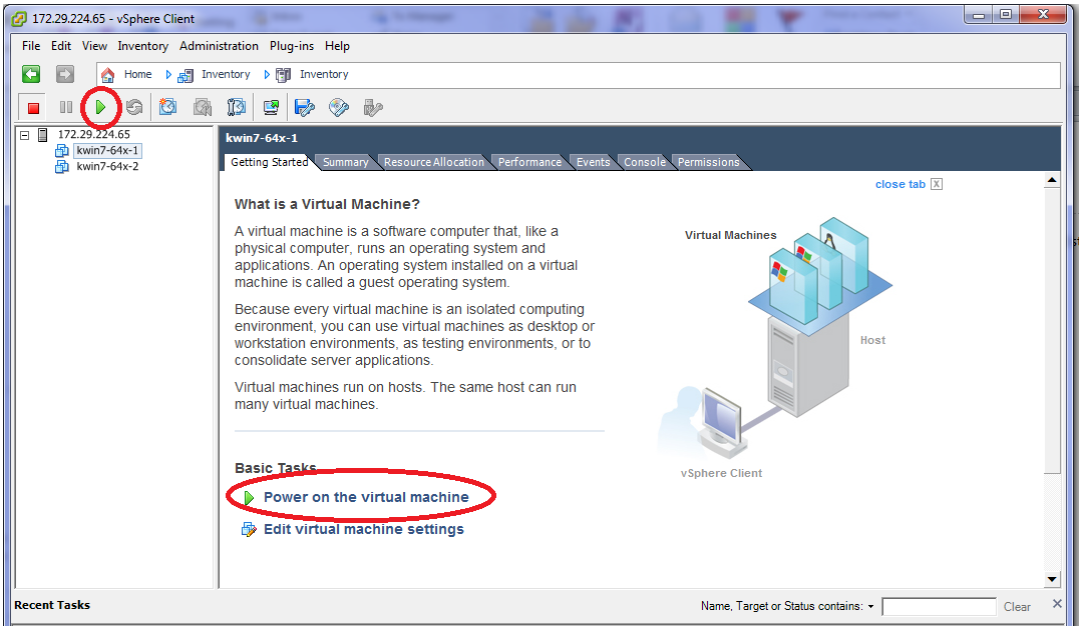
6. After a few minutes, the OS image will be uploaded to /vmfs/volumes/datastore1 as below.



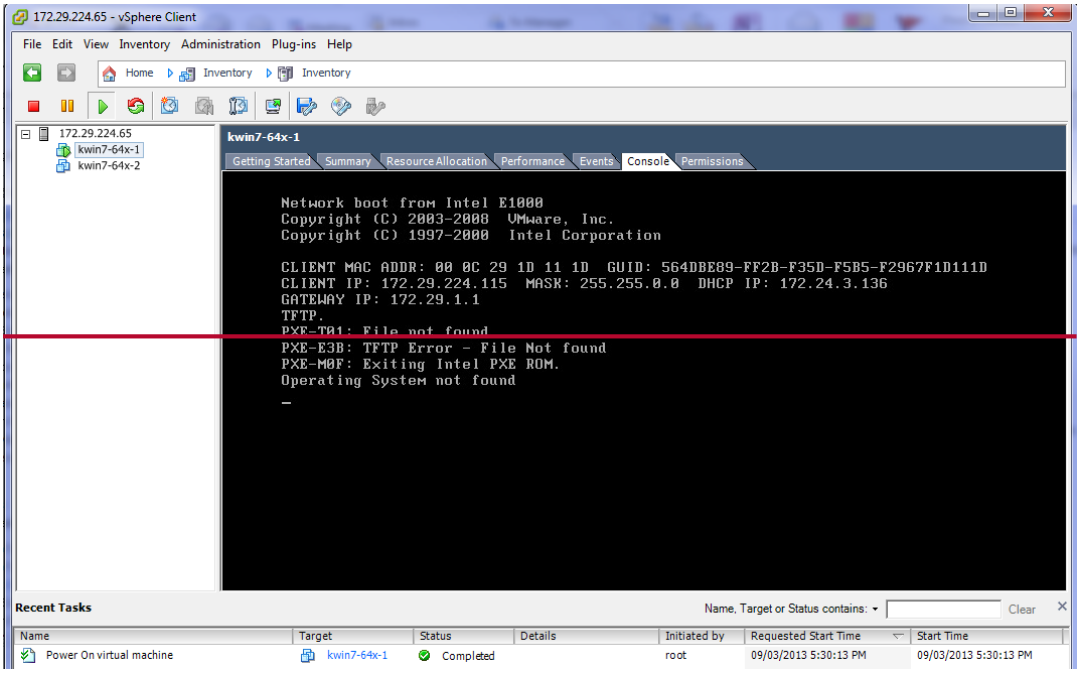
7. This ISO image can now be used to install a fresh OS on the virtual machine.

3.2.4.2 Install the OS

1. Start vSphere client application and connect to the host. Expand the host description (host name or IP address) and click on the virtual machine that was just created. Click on the start button or "Power on the virtual machine". Click on the "Console" tab.

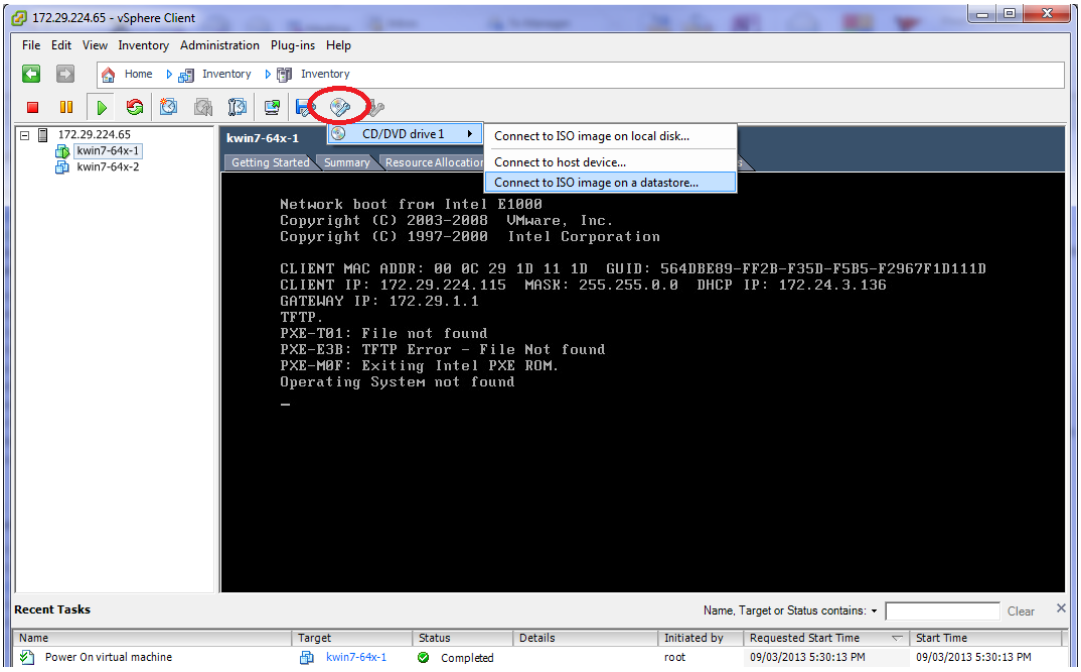


2. The console window should show that an operating system was not found :

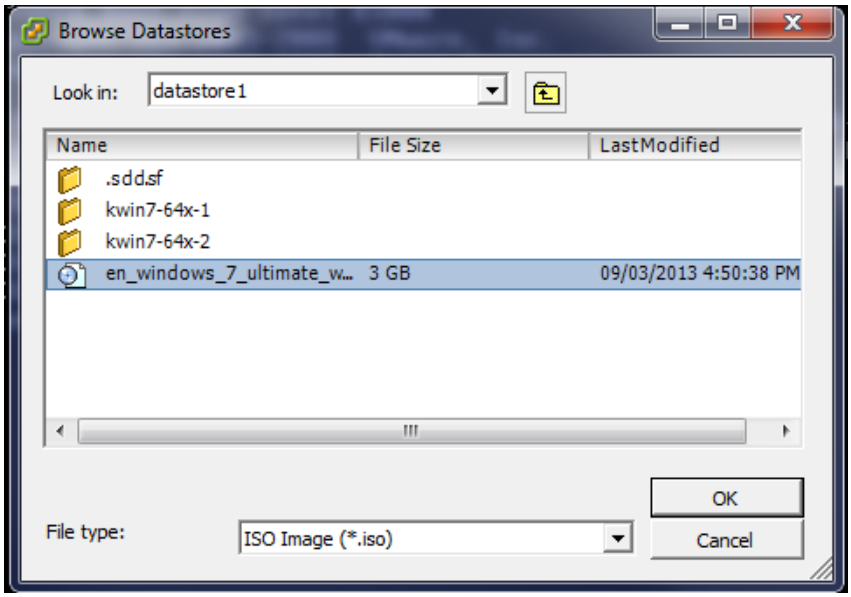


3. Click on the CD button, select the drive and select “Connect to ISO image on a datastore…”, as shown below.

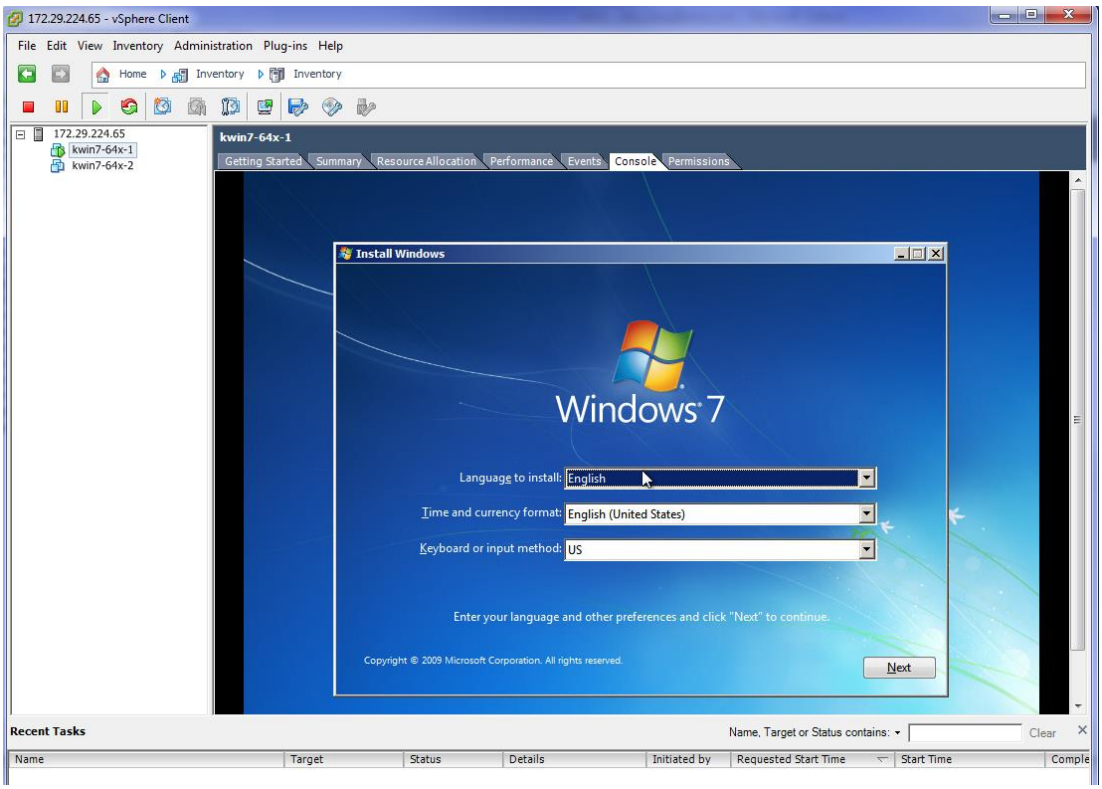
   (note: selecting option “Connect to ISO image on a local disk” will result in navigation to the administrator system local disk image. That installation method is the same as this method).



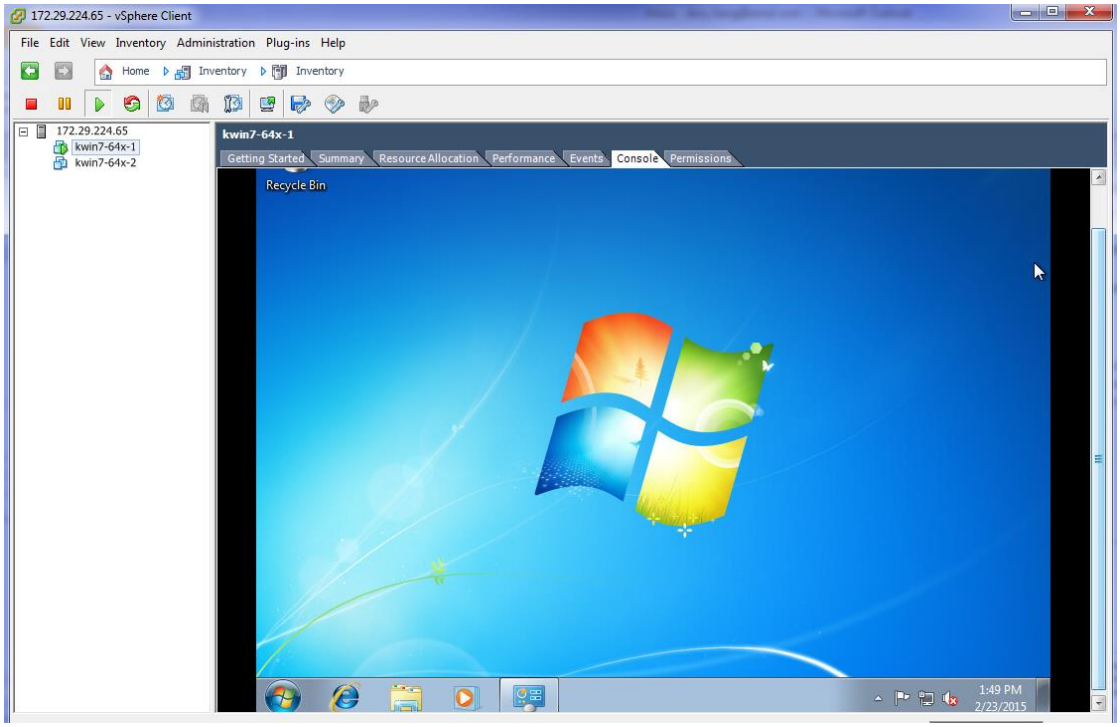
4. Once the “Browse Datastores” window appears, navigate to datastore1, select the OS ISO image previously uploaded and click on “OK” :



5. Use a mouse click on the console window followed by an ‘enter’ or ‘space’ key. The OS installation screen appears in the console window as it would on a desktop monitor during the regular install process.



6. Follow the normal Microsoft® Windows® installation procedure. Select a user name and password and allow the installation to complete. Once the installation completes, it shows the desktop of the guest OS in console window similar to below.

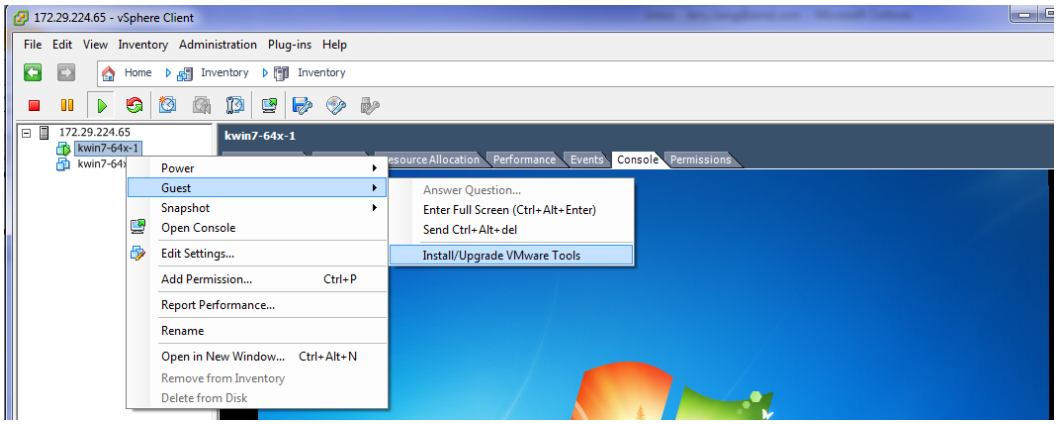


7. There might have some updates that will require rebooting of the OS. After the reboot(s), the guest OS is ready to use.

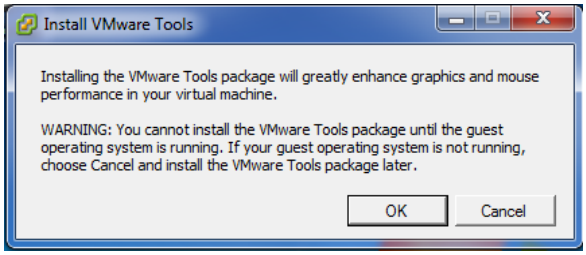
3.2.4.3 Install VMware Tools

It is necessary to install VMware tools to enable connectivity features between the virtual machine running on the host and the administrator system.

1. Once the guest VM boots to desktop, in the vSphere client, select the summary tab of the VM and click on “Install VMware Tools” :



2. A pop-up window will appear as the following :



3. Click OK to continue. After a few minutes (depending on network speeds), an AutoPlay window will appear as the following :

4. After clicking on “Run setup64.exe”, an installation window will be shown.

5. Follow the instruction on the screen, select "Typical" when prompt for setup type

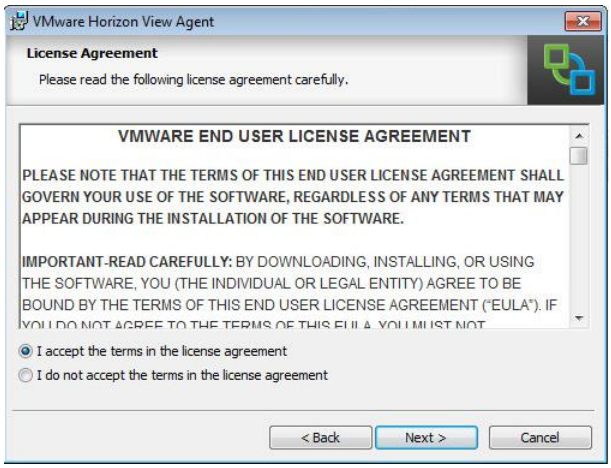
6. Once the installation is complete, a reboot of the virtual machine is required.

3.2.4.4 Install Horizon View Agent

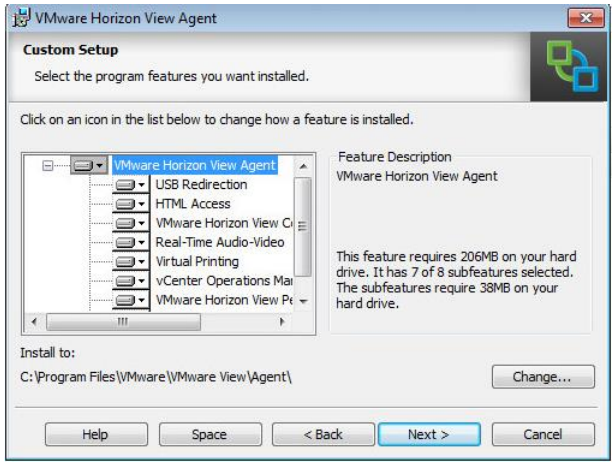
The Horizon View Agent acts as an intermediary software between the virtual machine and Horizon View (that is to be installed on the client terminal later). The Horizon View Agent Direct-Connection Plugin allows a View Client to directly connect to a View desktop without using View Connection Server.

1. Once the guest VM boots to desktop again, download Horizon View Agent indicate on **Table 1**.

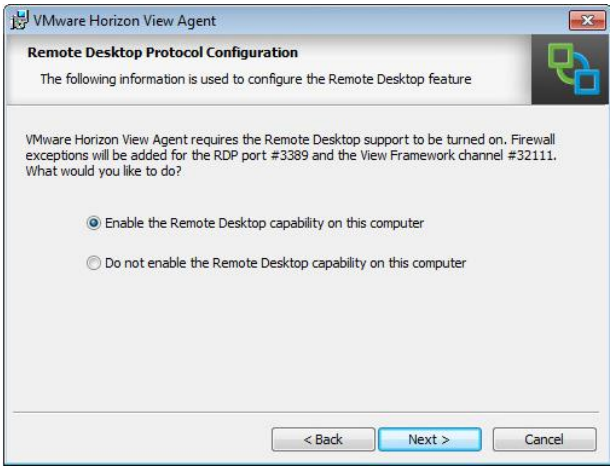
2. Run this application and accept the license agreement



3. On "Custom Setup", click on next without changes :



4. Select “Enable the Remote desktop capability on this computer” :



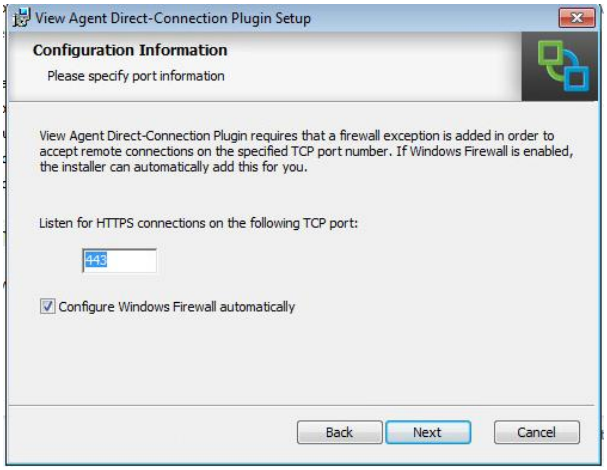
5. Click “Install” in next window. The View Agent will be installed on this guest VM.

6. Once the installation completes, a prompt for reboot will appear.

7. After reboot, continue with downloading the Horizon View Agent Direct-Connection plug-in indicated on **Table 1**.

8. Run this Direct-Connect plug-in and accept the License Agreement

9. Click on Next and make sure Configure Windows Firewall automatically is selected :



10. Click on the Next to install the Direct-Connection Plugin. Once installation is complete, reboot the guest VM.

3.2.1 Pass Through Device to Guest VM

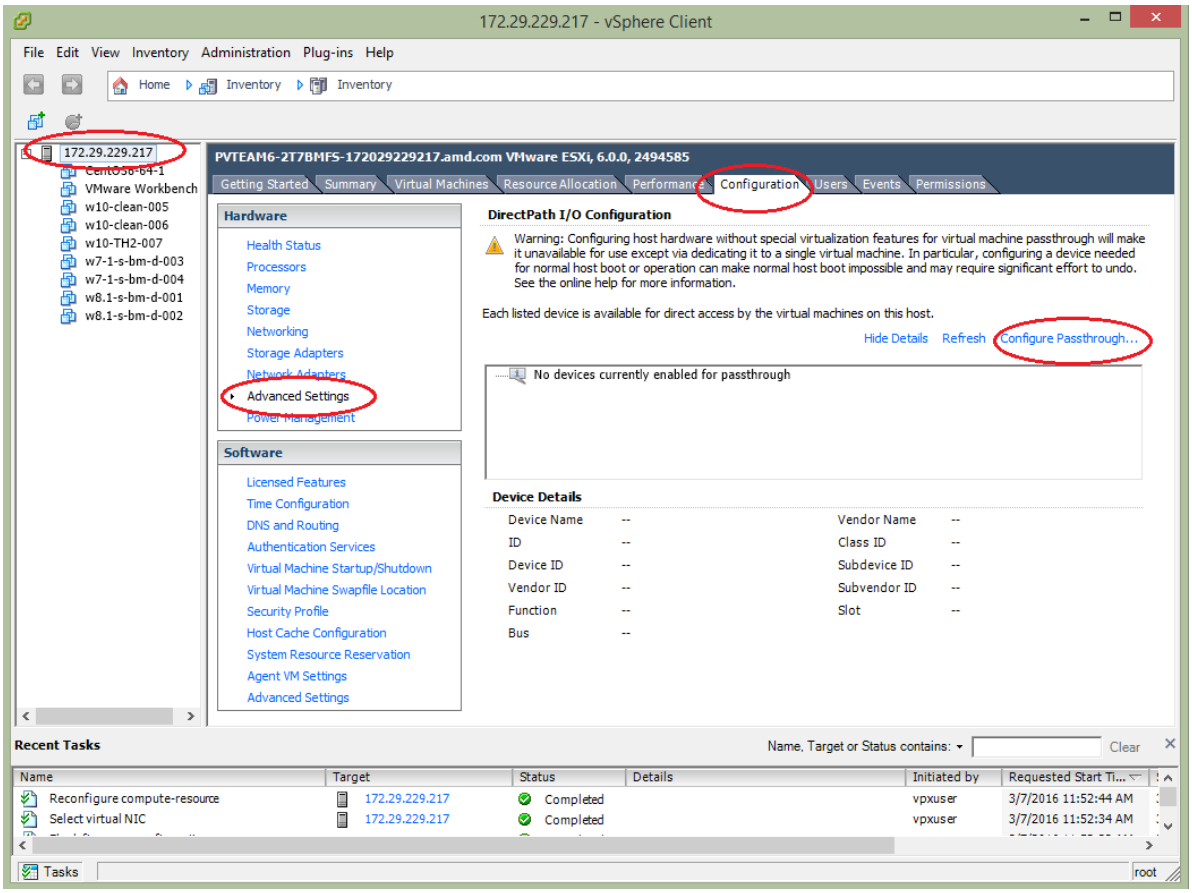
Passing through a device to the guest VM means providing full access of the device residing in the host to that VM. After passing through a GPU, a VM is able to access the full hardware acceleration capabilities of that GPU remotely.

MxGPU operates as a number of devices that can be passing through to various VMs. Therefore gaining knowledge about how to pass through a single GPU device to a single VM allows the user to understand the first steps necessary to install MxGPU.

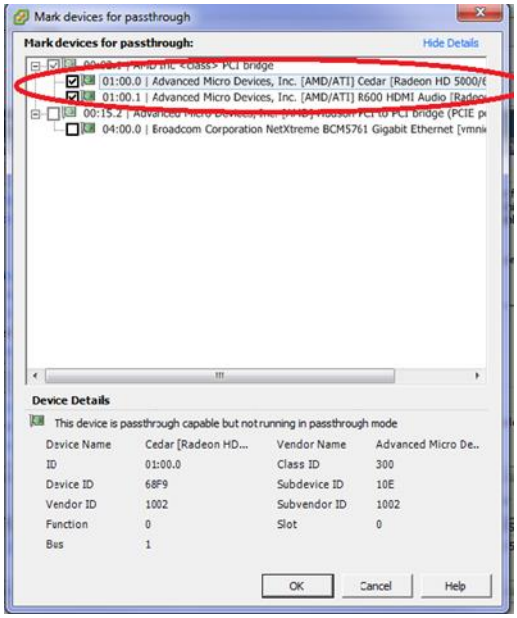
If the user already has a basic understanding of how to pass through a GPU device to the VM, then this section can be bypassed.

3.2.1.1 Select Device for Pass Through

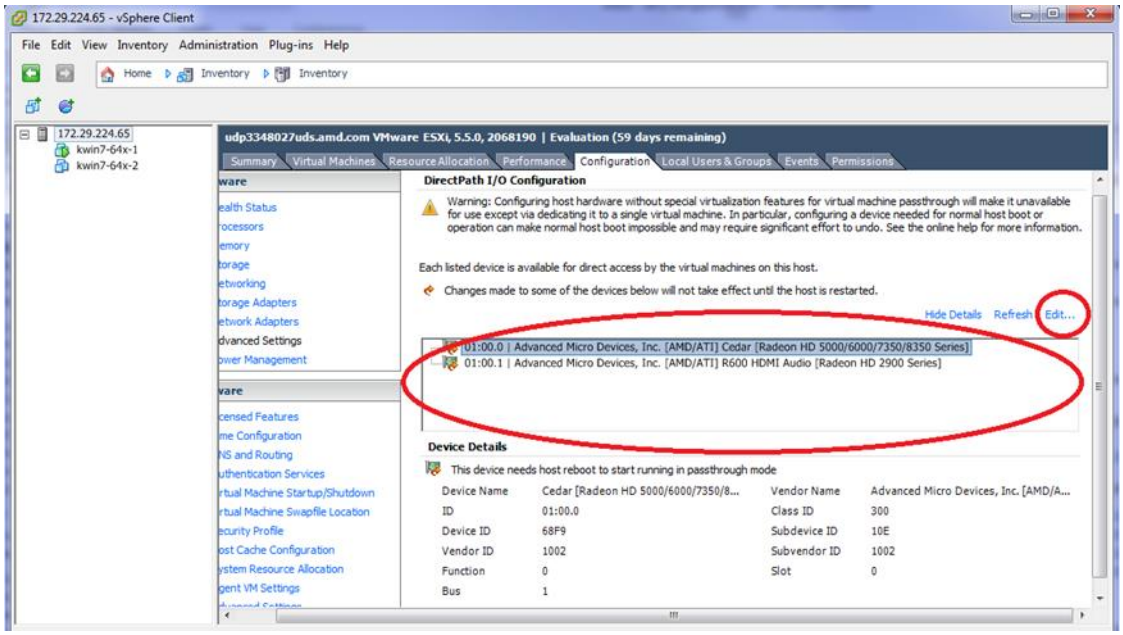
1. In the vSphere host client, click on the host description. Select the “Configuration” tab, click on “Advanced Settings” and select “Configure Passthrough…” as the shown below :



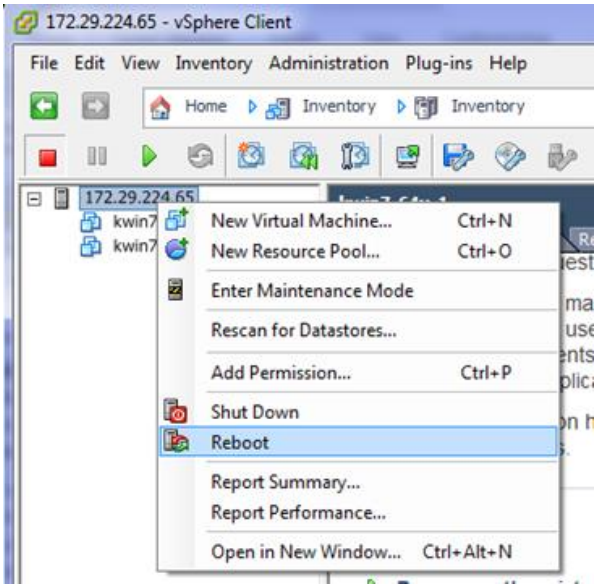
2. A window with devices available for passthrough will appear. Select the desired passthrough device and click on the OK button.



3. The selected device appears in the “Direct Path I/O Configuration” window list. Use the “Edit” link to change/edit the list.



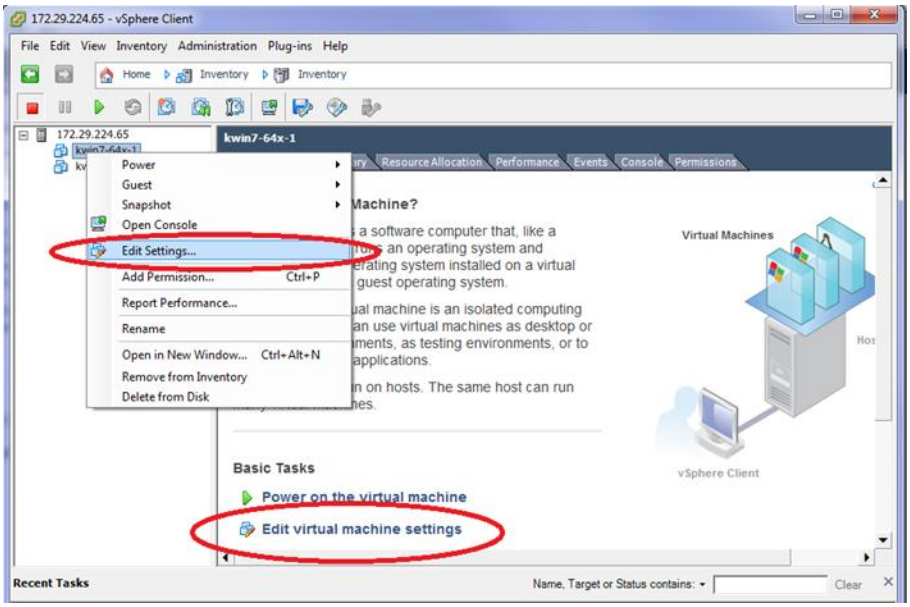
4. The host reboot is required before host “releases” the new devices and makes them available for passthrough to a guest VM. To reboot the host, right click on the host description and navigate to “Reboot”. Note: make sure all guest VMs are already shut down before rebooting the host.



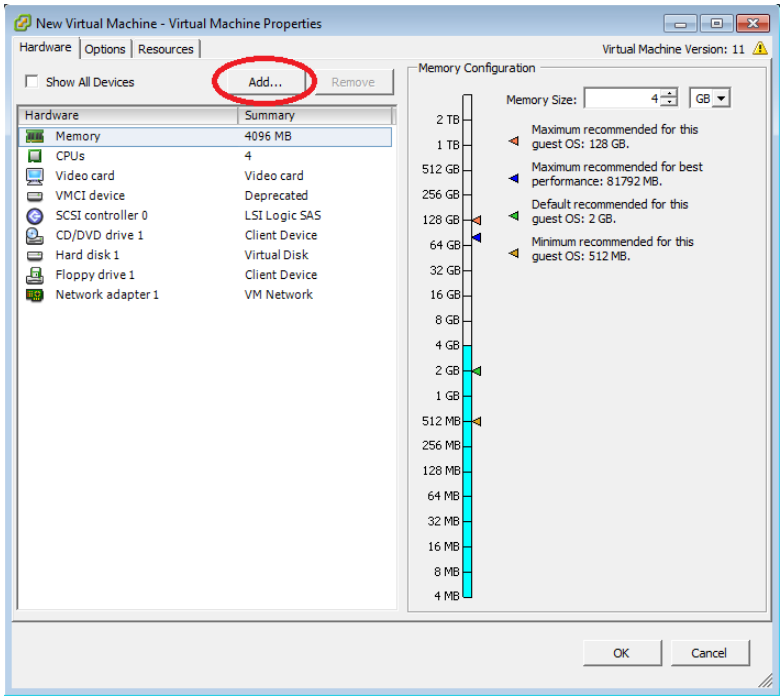
3.2.1.2 Assign Device to Guest VM

1. After the host reboots, reconnect to host through vSphere client. Ensure that the guest VM targeted for GPU passthrough is shut down.

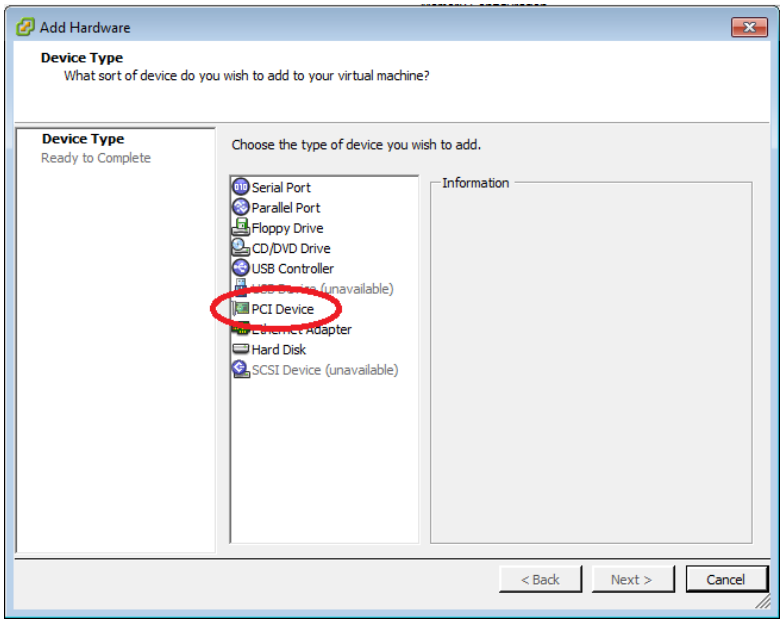
2. Right click on the guest VM and navigate to “Edit Settings…” or click “Edit virtual machine settings” in the Getting Started tab.



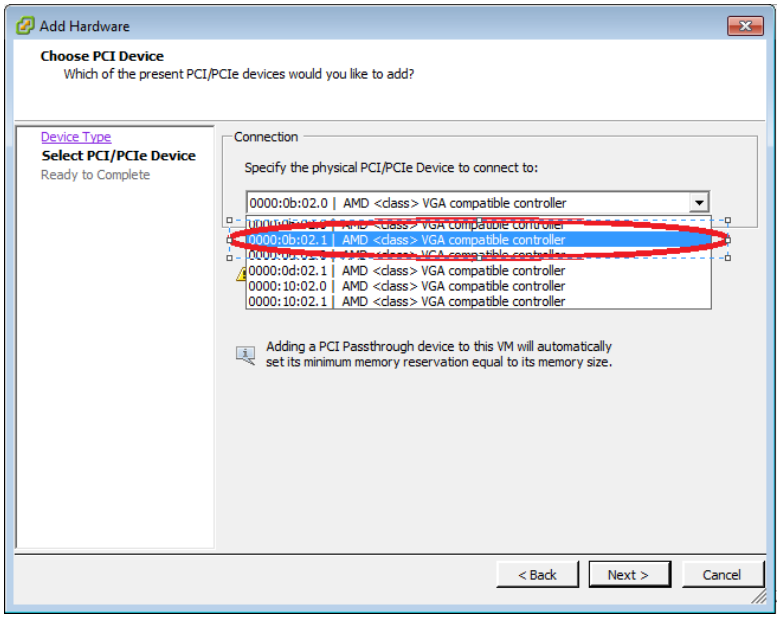
3. A window showing the virtual machine setting will appear as shown. Click on the “Add” button.



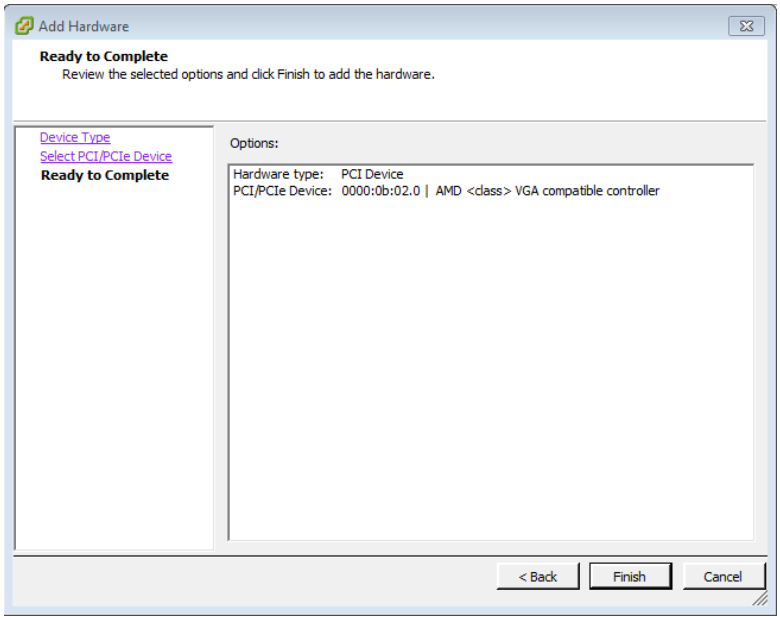
4. An “Add Hardware” window appears. Select “PCI Device” and click on next.



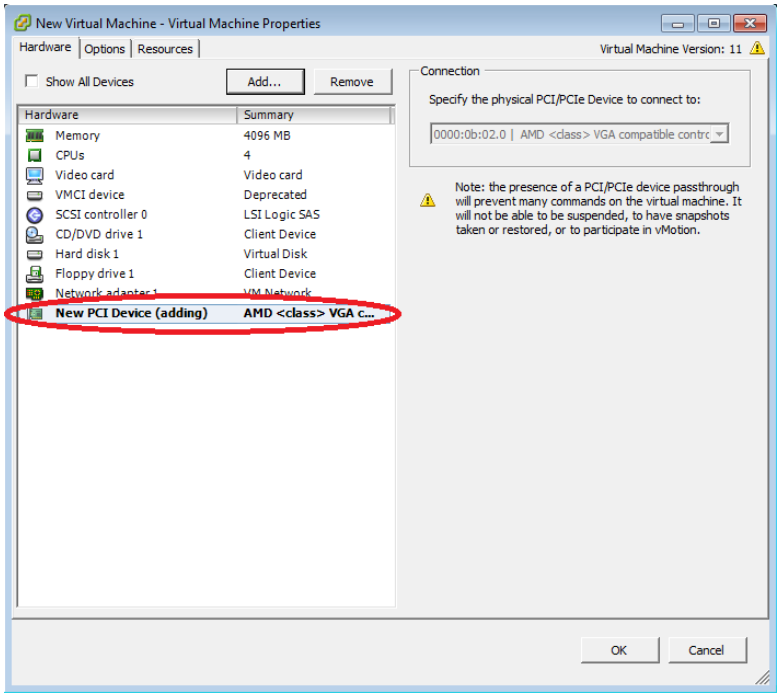
5. A “Choose PCI Device” window will appear. Choose the device from the list box, then click “Next”.



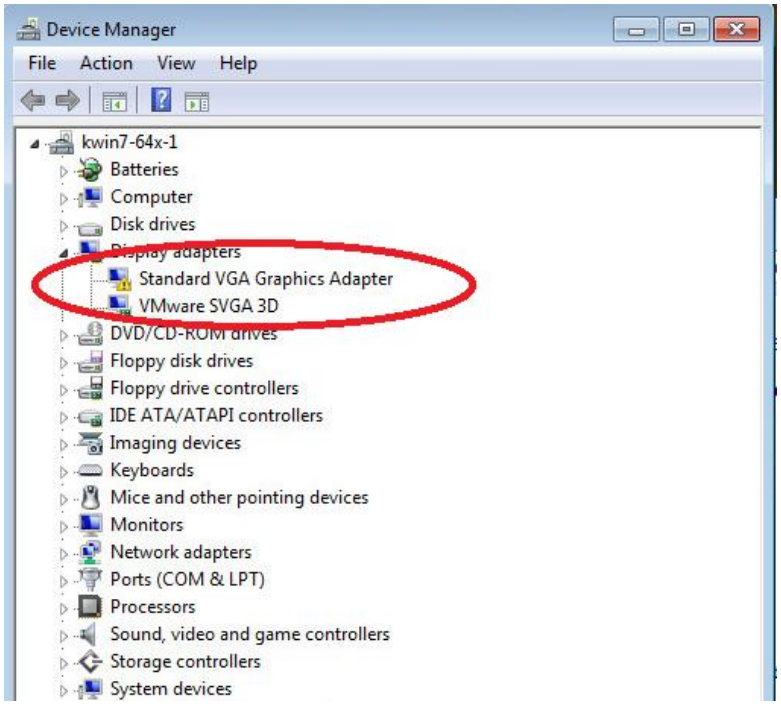
6. The “Ready to Complete” window appears with the device just selected. Click on the “Finish” button.



7. The device is now part of the guest VM's hardware list. To pass through additional devices, repeat the steps in this section.



8. Once the guest VM is powered on, the passthrough device becomes a part of the guest VM's devices. To check that this is the case, open Device Manager and review the list of devices under "Display adapters". Before installation of the graphics adapter driver, the devices will appear as, "Standard VGA Graphics Adapter".



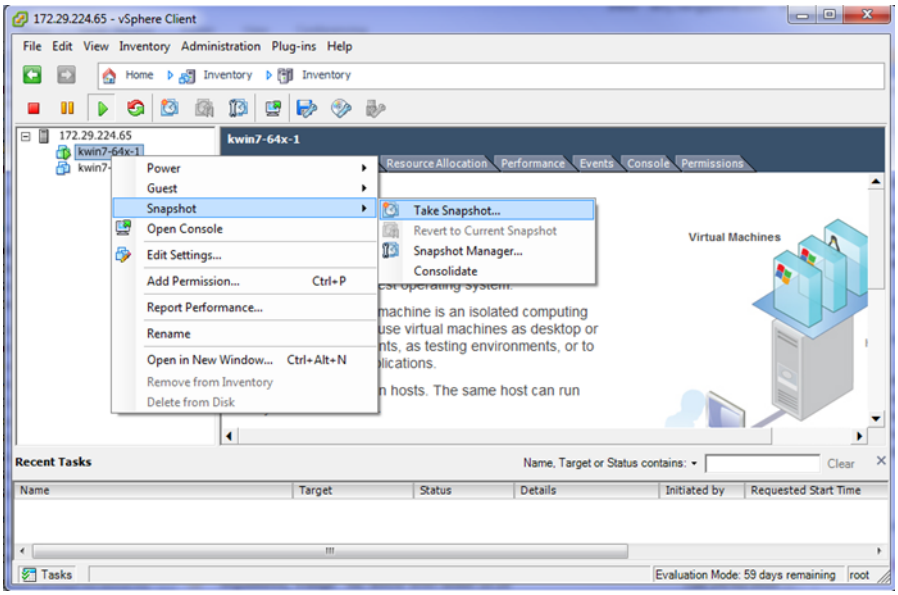
9. The next step is to install the graphics driver for the device.

3.2.2 Guest VM management

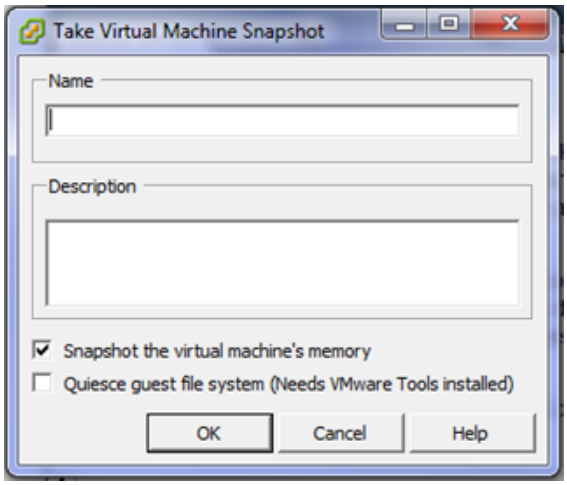
Once a guest VM is up and running, the Snapshot feature can be used to copy an instance of that VM at a particular state. This feature can be used to create stable backup points for the VM. This feature can also be used to create templates to deploy new VMs without going through the OS installation process.

3.2.2.1 Create and Use Guest VM Snapshot

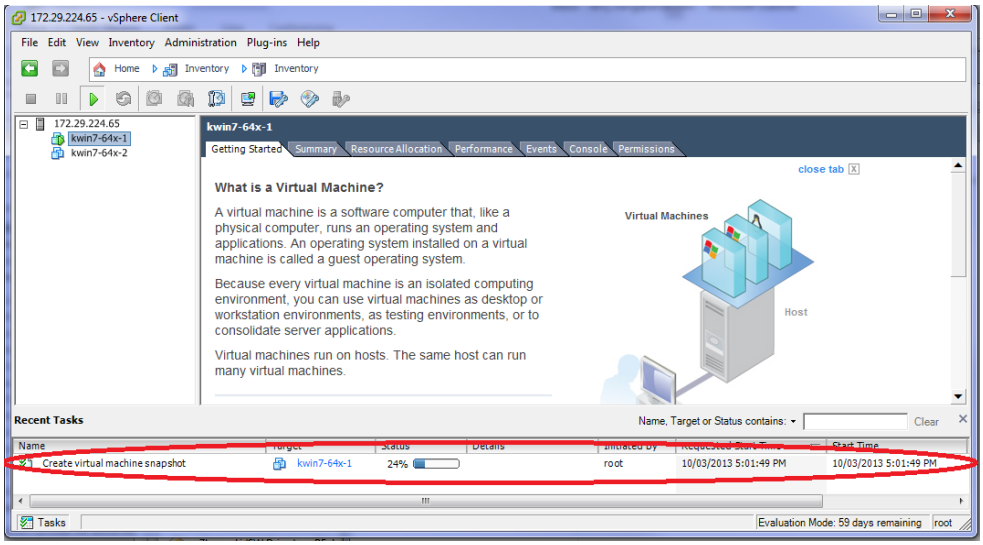
1. In the vSphere client, right click on the VM, navigate to Snapshot, and then "Take Snapshot…" :



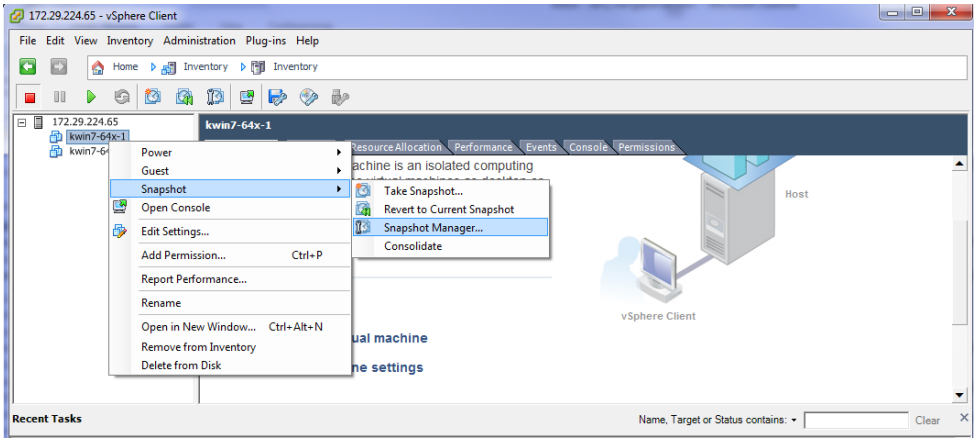
2. Enter a name and description as for the virtual machine snapshot.



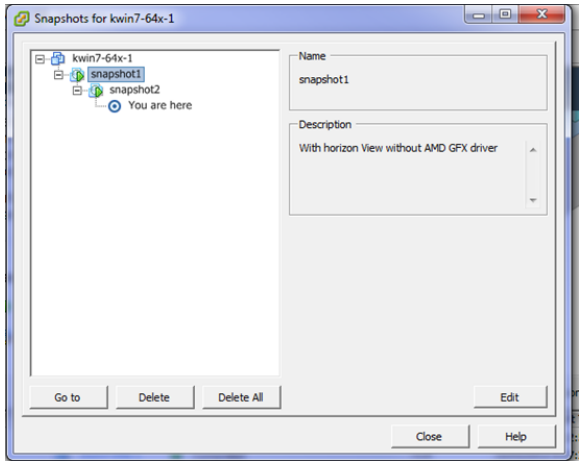
3. The snapshot process requires a few minutes to complete.



4. Once the snapshot is created and a rollback to that snapshot is required, shut down the guest VM, right click on the guest VM, navigate to “Snapshot” and then “Snapshot Manager…” :



5. Select the snapshot and click on the “Go to” button. Click “Yes” in the warning window to complete the reversion of the VM back to the state when the snapshot was taken.

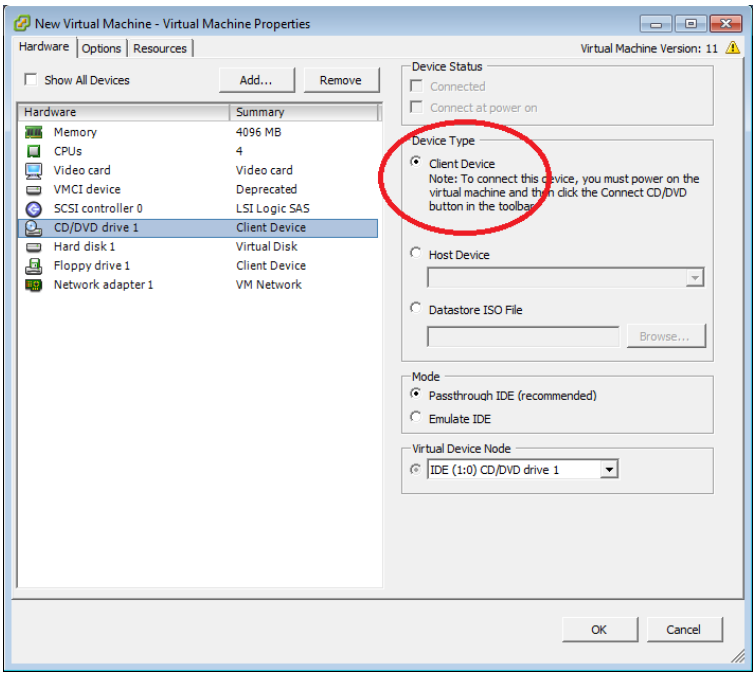


3.2.2.2 Create Guest VM Template

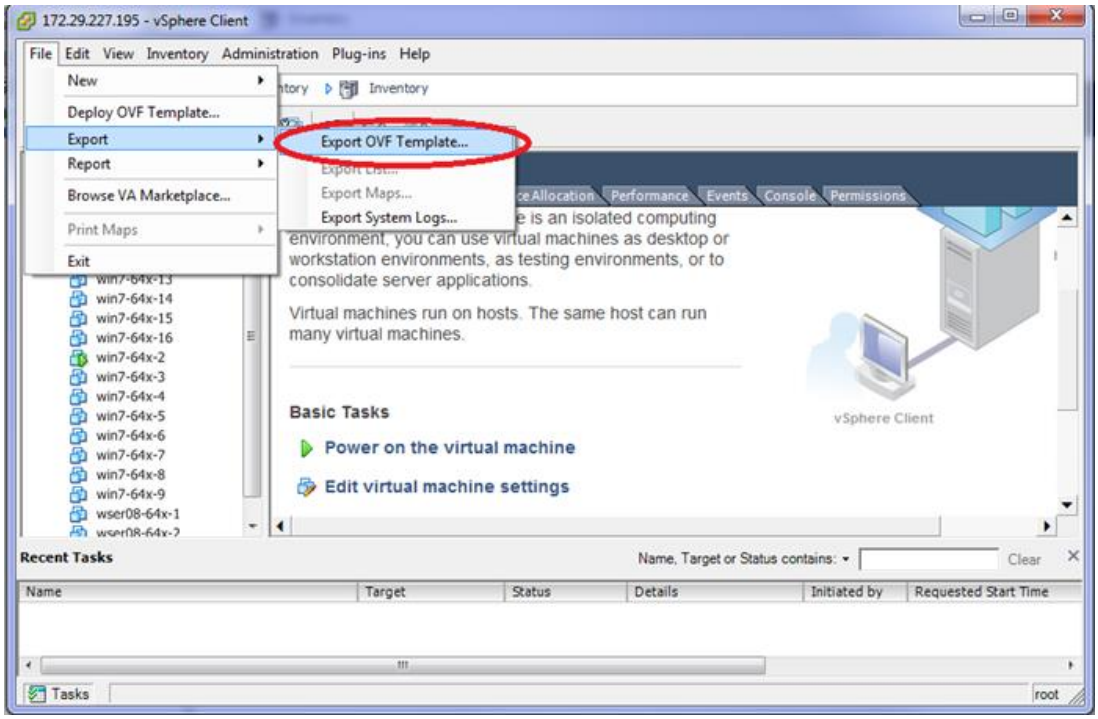
1. To create a template, ensure that the guest VM used for the template

   a. Does not have any pass through devices

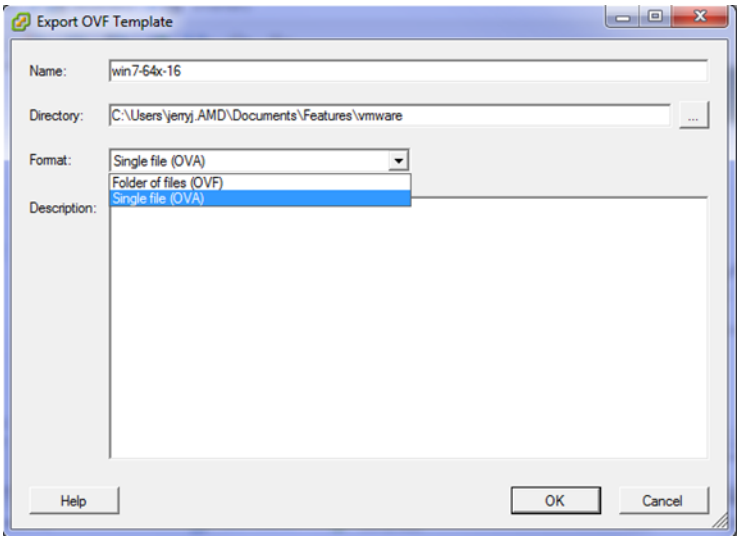
   b. CD/DVD drive is set to Client Device



2. Select the guest VM that will be used as a template. Click on “File” and navigate to “Export”, then “Export OVF Template...”. If the guest VM has any passthrough devices, a warning window will pop up to prevent the export operation.



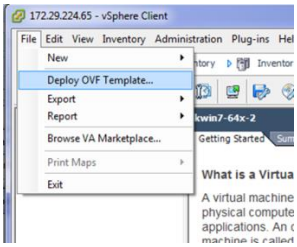
3. In the pop up window, input a descriptive name for this template; select a location to save the template. Select single file (OVA) or folder of files (OVF), and (optionally) add a description for this template.



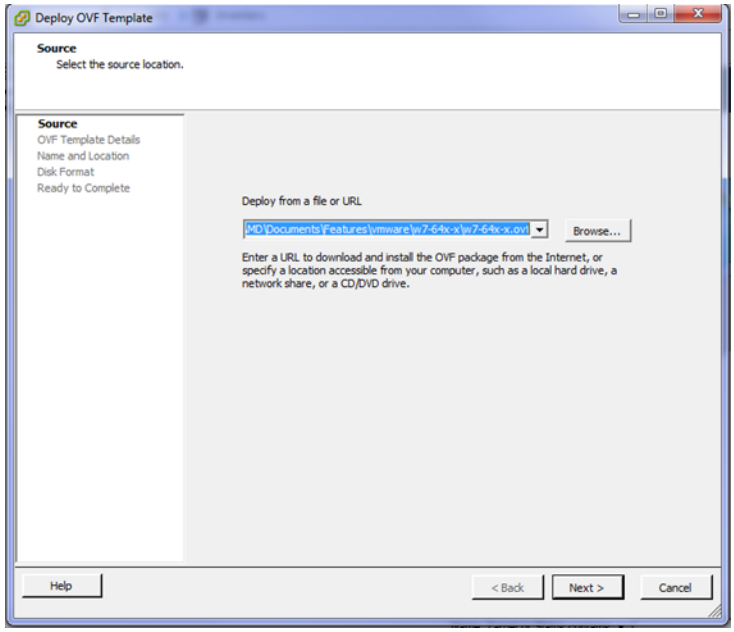
4. It will take some time to create the template. Once the template is created, it can used to deploy guest VMs with the same content and settings as the original VM.

3.2.2.3 Deploy Guest VM Through Template

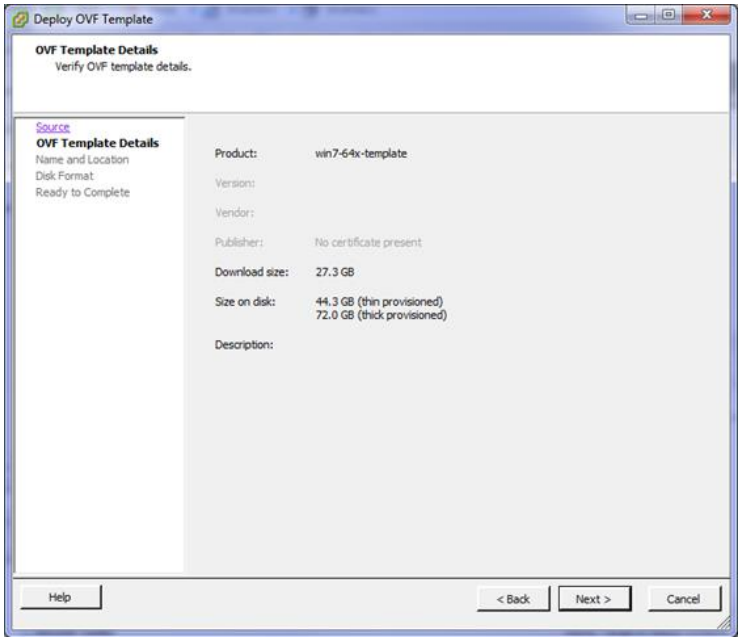
1. Right click on the host name and navigate to “Deploy OVF Template…” :



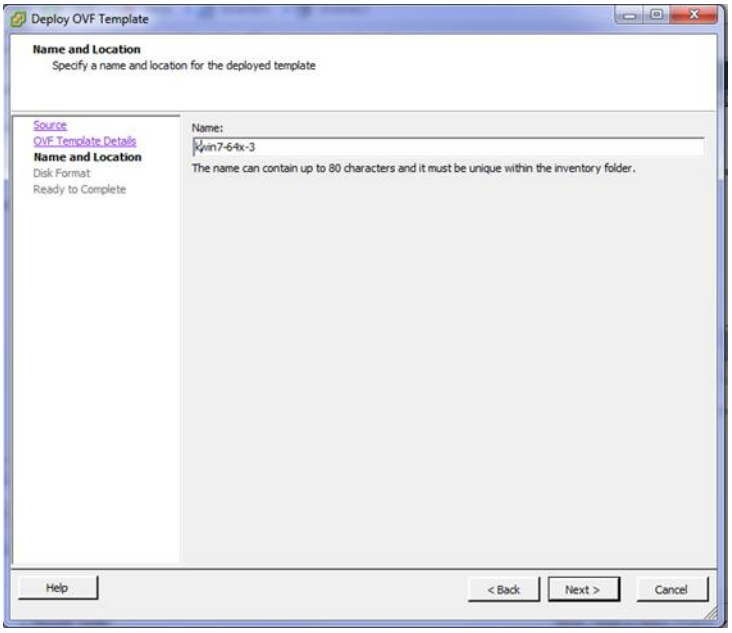
2. A window will pop up. Use the “Browse” button to find the template.



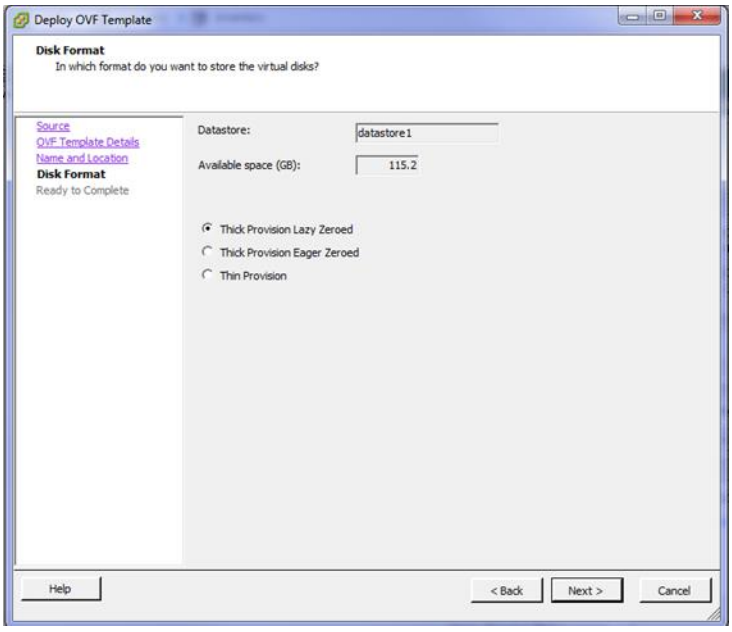
3. After clicking on Next, details of the template will be shown :



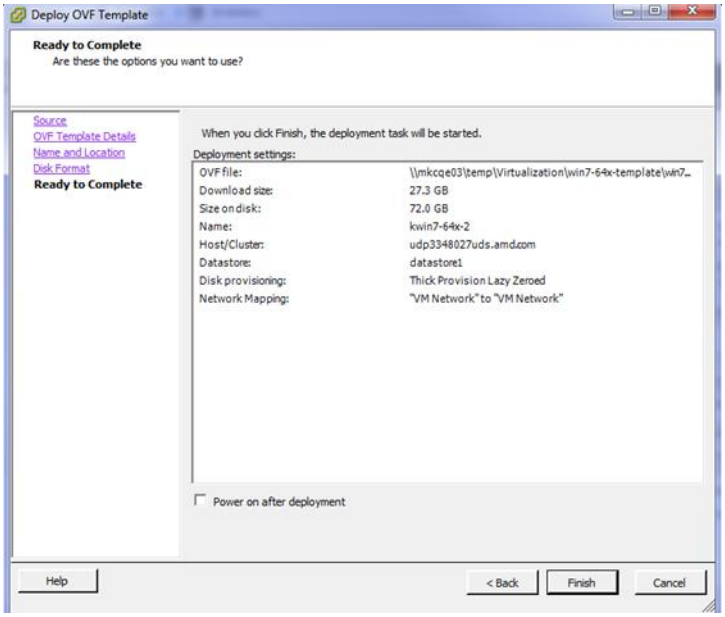
4. Click on Next and enter a name for the new guest VM :



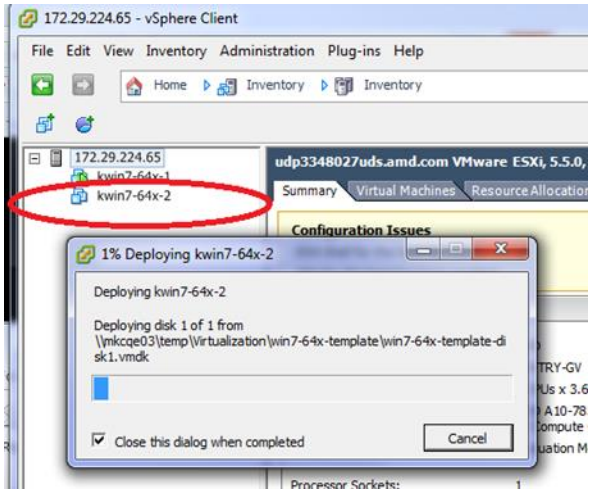
5. After clicking on Next, ensure that “Thick Provision Lazy Zeroed” is selected.



6. After clicking on Next, a summary page will show the details of the VM to be created :



7. Click on Finish. A status window will show the progress of the deployment. A new VM appears under the host description.



8. It will take some time for vSphere to finish the deployment. Once complete, the VM can be started. At this point, passthrough devices can be assigned to the device, as required.

3.3 Client System Setup

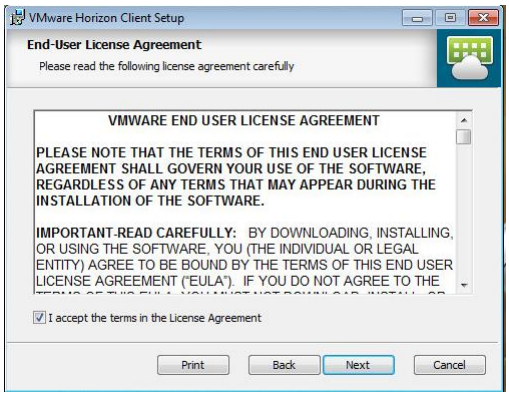
Once the virtual machines are created in the host server, there are two methods for accessing these VMs :

- Connect through a Horizon View client on a laptop, desktop or thin client system
- Connect through a zero client
-

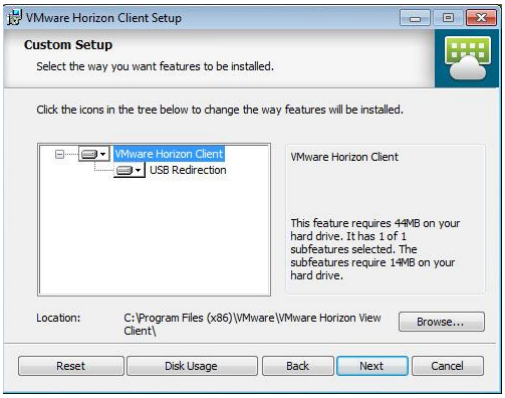
3.3.1 Horizon View Client Setup

1. On the client system or administrator system, download Horizon View indicated on **Table 1**.

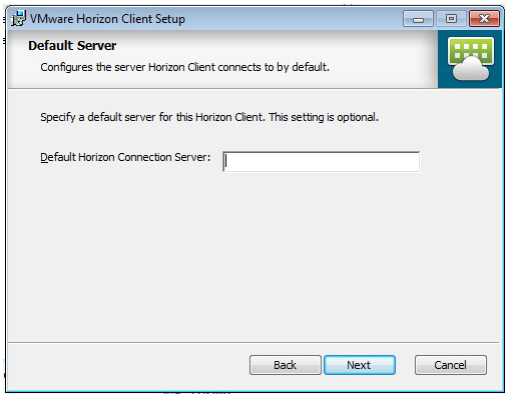
2. Run this application and accept the License Agreement



3. Click on Next and accept all the default features selected :

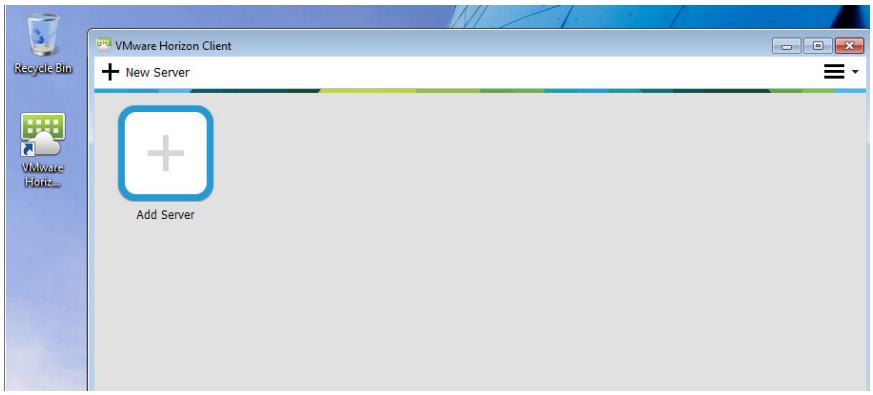


4. Ignore the Default Server, leave the Default Horizon Connection server empty and click on Next :

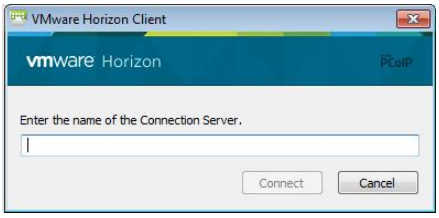


5. Create the desktop shortcut and start menu shortcut. On next page, click on Install to complete the installation.

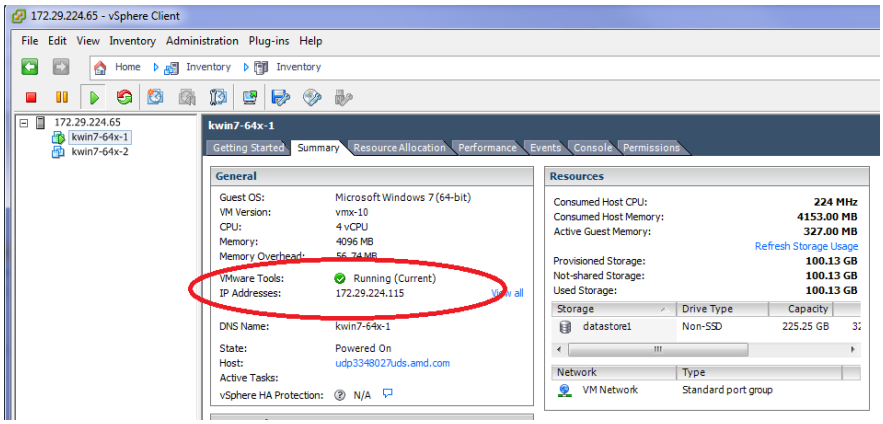
6. Once the installation completes, launch Horizon View. The following window appears :



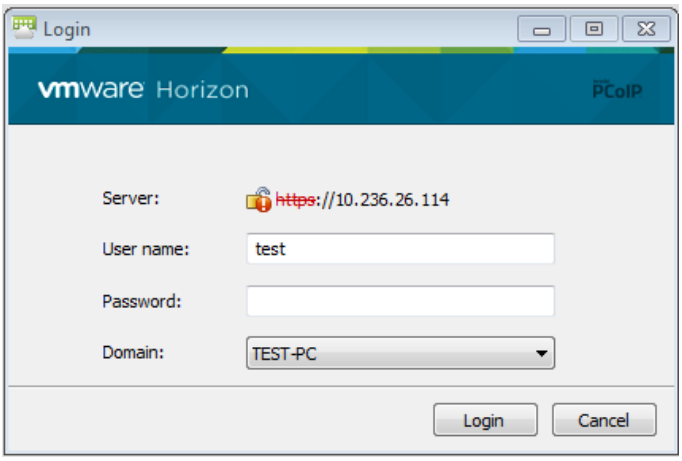
7. Clicking on “Add Server” will pop up a window that prompts for the connection target :



8. Type in the IP address of the guest VM to connect with. The IP address of the guest can be found at guest VM summary page in the vSphere client application.



9. Click on the connection button after entering the IP address. A window will pop up asking for user name and password. Enter the guest VM’s user name and password, then click Login button.

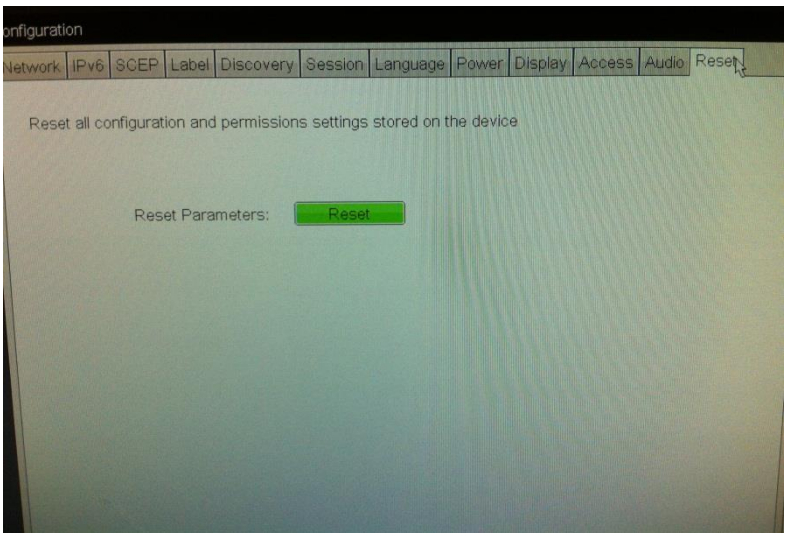


10. After logging in, the virtual machine desktop will automatically snap to full screen size of the connected monitor.

3.3.2 Zero Client Setup

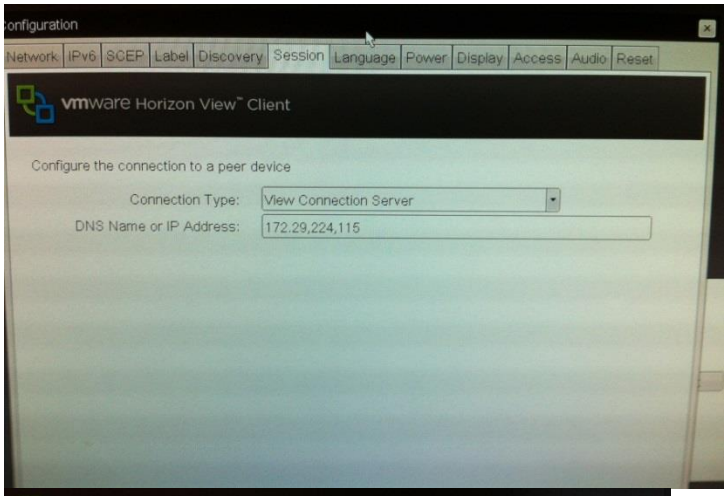
1. Connect monitor, keyboard, mouse, network to the zero client

2. If this is the first time using this zero client or the zero client has been used within other network, click on the top-left corner select options-> Configuration. Navigate to Reset tab as the following – this step is only needed for the first time that a zero client is connected on the test network.

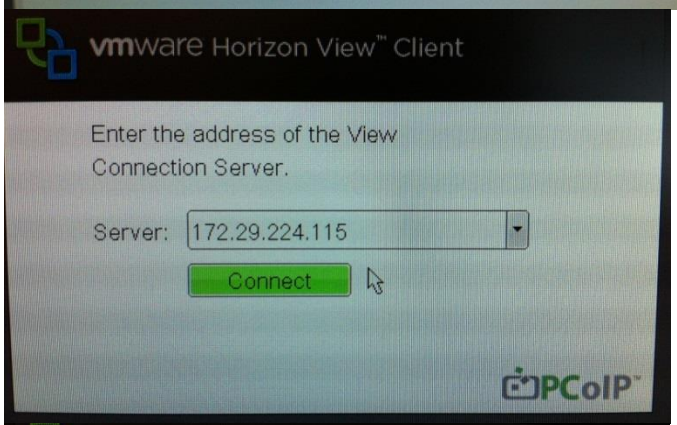


3. Click on reset, and click on Yes button. After a few minute, the system will reboot.

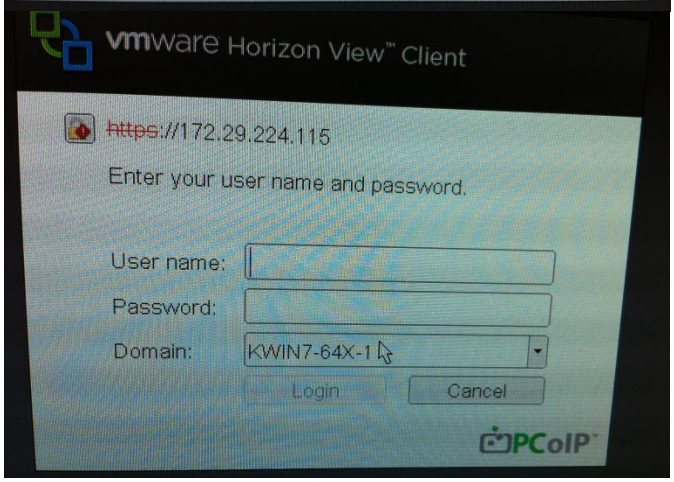
4. After reboot, click on the top-left corner select options-> Configuration. Navigate to Session, and select view connection server from the connection Type, type in the IP address of the guest VM



5. Click on apply, and close the windows. The screen will have a connection window as:



6. Click on the connect button a connect window will show up as the following



7. Enter the user name and password, then click on login button. The desktop should show up on the monitor

   Note: If the monitor's resolution is too big (ex. 1920x1080), you might encounter black screen at this stage. Using a smaller native resolution monitor (ex. 1366x768) will work around the problem at this step. The larger monitor will be supported once the AMD driver is installed.

3.4 GFX Driver Installation under Guest VM

The sequence described in this section applies to the AMD GFX driver installation in a guest VM. MxGPU uses SR-IOV to replicate one device into several virtual devices that can then be configured for pass through. The procedure for installing the driver on a VM using an MxGPU device is the same procedure as installing the driver on a VM using a regular passthrough device under vDGA. The following installation sequence is based on the Horizon View Agent 6.1.0 and higher. The steps for setting up a virtual machine are summarized:

1. Create a guest VM and fresh install guest VM without GPU pass through. Refer to section **0** and section **3.2.4.1** – reboot the guest VM.

2. From vSphere client and VM console, install VMtools. Refer to section **3.2.4.3** - reboot the guest VM.

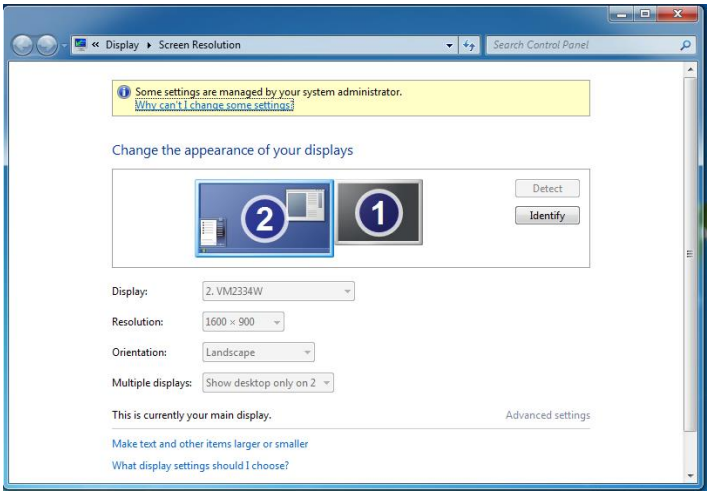
3. From vSphere client and VM console, install unified Horizon View Agent and Horizon View Agent Direct Connection. Refer to section **3.2.4.4** – shutdown the guest VM.

4. From vSphere client, assign an AMD GPU device to this guest VM. Refer to section **3.2.1** - start the guest VM.

5. Wait until an IP address appears for the guest VM in Summary tab. Start the Horizon View client application from client system, configure as “PCoIP and full screen” and connect to guest VM. Refer to section **3.3** for details.

6. Log into the guest VM and obtain driver package. Start installing GFX driver for the pass through device. After installation completes, a reboot of the VM is required.

7. After reboot and IP address of the virtual machine appears in the Summary tab, from client system (desktop/laptop), connect to guest VM again. Right click on the desktop, select screen resolution. The screen resolution window appears and reports the resolution similar to the following :



8. If a window similar to the above appears then the AMD GFX driver is properly installed and the vSGA desktop is disabled.

4. Setup MxGPU

The following sections describe the steps necessary to enable MxGPU on the graphics adapter(s) in the host. Before proceeding, refer to the Appendix to ensure that the host system is enabled for virtualization and SR-IOV (section **5.1**). Once virtualization capabilities are confirmed for the host system, follow the steps in the next two sections to program the graphics adapter(s) for SR-IOV functionality and to connect the virtual functions created to available virtual machines.

4.1 Programming SR-IOV Parameters for MxGPU

1. Download and unzip the vib and MxGPU-Setup-Script-Installer.zip from **Table 1**.

2. Copy script and vib file to the same directory (Example : /vmfs/volumes/datastore1)

3. Using an SSH utility, log into the host and change the attribute of mxgpu-install.sh to be executable

4. Run command: ./mxgpu-install.sh ./<amdgpuv…vib>
   - If a vib driver is specified, then that file will be used. If no vib driver is specified then the script uses the vib in the current (same) directory.
   - The script will display all available AMD adapters.

5. Next, the script will show three options : **Auto/Hybrid/Manual**

   1) **Auto** : automatically creates a single config string for all available GPUs : Easiest
   - the script prompts for one input (the number of virtual machines desired) and sets all other settings accordingly (frame buffer, time slice, etc.)
   - these settings are applied to all AMD GPUs available on the bus
   - the script installs amdgpuv…vib and prompts for reboot

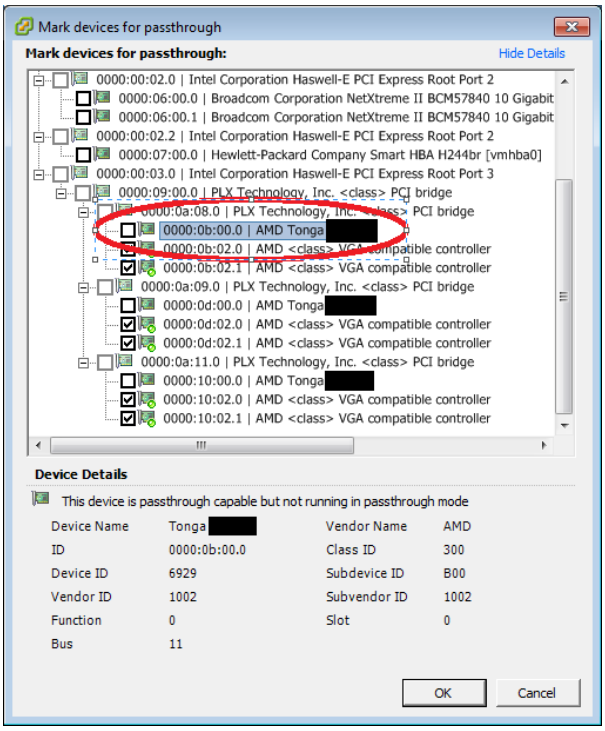
   2) **Hybrid** : allows each GPU to be configured differently : Medium
   - the script prompts for one input (the number of virtual machines desired) and sets all other settings accordingly (frame buffer, time slice, etc.)
   - these settings are applied to the selected AMD GPU; the process repeats for the next GPU
   - the script installs amdgpuv…vib and prompts for reboot

   3) **Manual** : configures each GPU one by one prompting for individual settings : Advanced
   - the script prompts the user to select one of the GPUs,
   - the script prompts the user to enter VF number, FB size/VF, time slice
   - these settings are applied to the selected AMD GPU; the process repeats for the next GPU
   - the script installs amdgpuv...vib and prompts for reboot

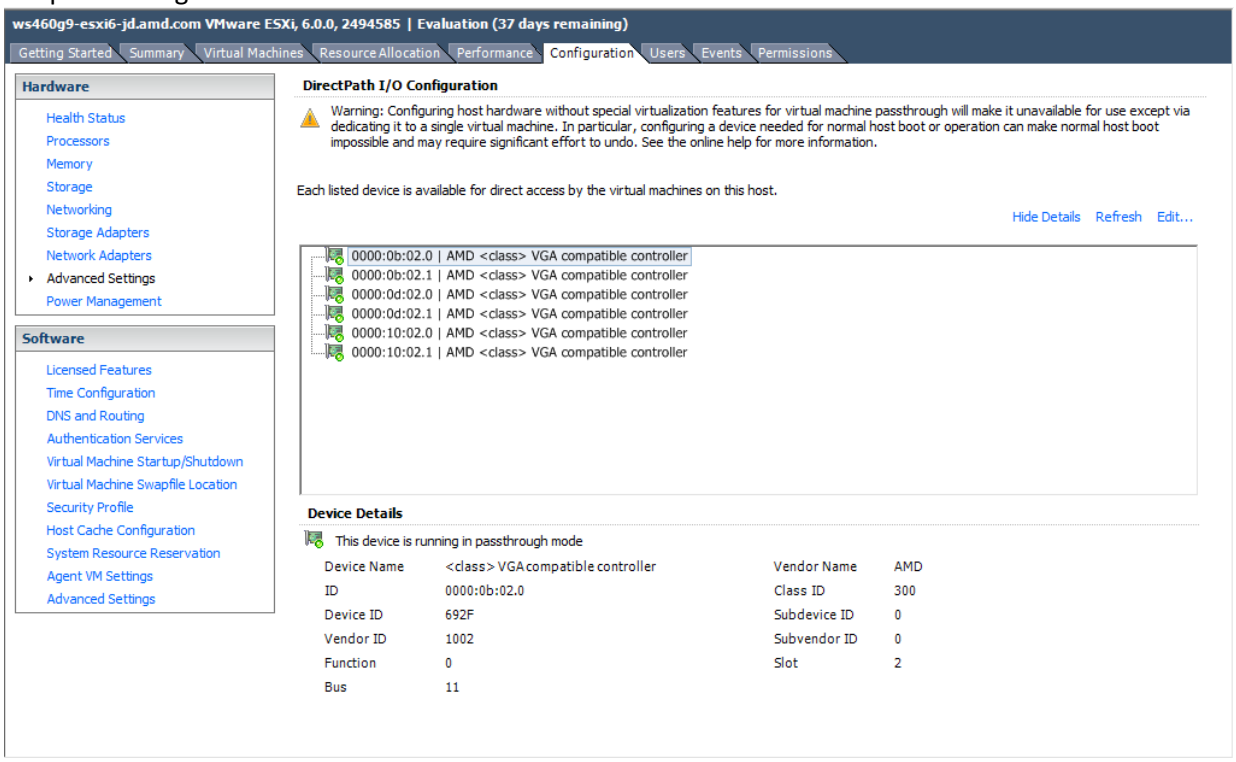
For users who want to understand the individual steps required for vib installation and configuration, section **5.2** provides more advanced steps.

4.2 VF Pass Through

The steps for physical device (physical function) passthrough is detailed in section **3.2.1**. Once the VFs (virtual functions) are set up, then passing through theses VFs follows the same procedure. To successfully pass through the VFs, the physical device CANNOT be configured as a passthrough device. If the physical device is being passed through to the VM, then the GPUV driver will not install properly. If that happens, the VFs will not be enabled and no VFs will be shown.



Once the VFs are enabled, they will be listed in the available device list for pass through, and the status of the PF will be changed to unavailable for pass through. No additional operation is needed to move VF into pass through device list.



5. Appendix

5.1 Host Server Configuration

To enable the MxGPU feature, some basic virtualization capabilities need to be enabled in the SBIOS. These capabilities may be configured from the SBIOS configuration page during system bootup. Different system BIOS vendors will expose different capabilities differently. Some may have one control that enables a number of these capabilities. Some may expose controls for some capabilities while hardcoding others. The following settings, taken from an American Megatrends system BIOS, provides a list of the minimal set of capabilities that have to be enabled :

- **Server CPU supports MMU**

- **Server chipset supports AMD IOMMU or Intel VT-d**

The option “Intel VT for Directed I/O (VT-d)” should be enabled
Example Path : IntelRCSetup ➔ IIO Configuration ➔ Intel(R) VT for Directed I/O (VT-d) ➔ Intel VT for Directed I/O (VT-d)

- **Server (SBIOS) support PCIe standard SR-IOV**

The option “SR-IOV Support” should be enabled.
Example Path : Advanced ➔ PCI Subsystem Settings ➔ SR-IOV Support

- **Server (SBIOS) support ARI (Alternative Routing ID)**

The option “ARI Forwarding” should be enabled.
Example Path : Advanced ➔ PCI Subsystem Settings ➔ PCI Express GEN 2 Settings ➔ ARI Forwarding

- **Server (SBIOS and chipset (root port/bridge)) supports address space between 32bit and 40bit**

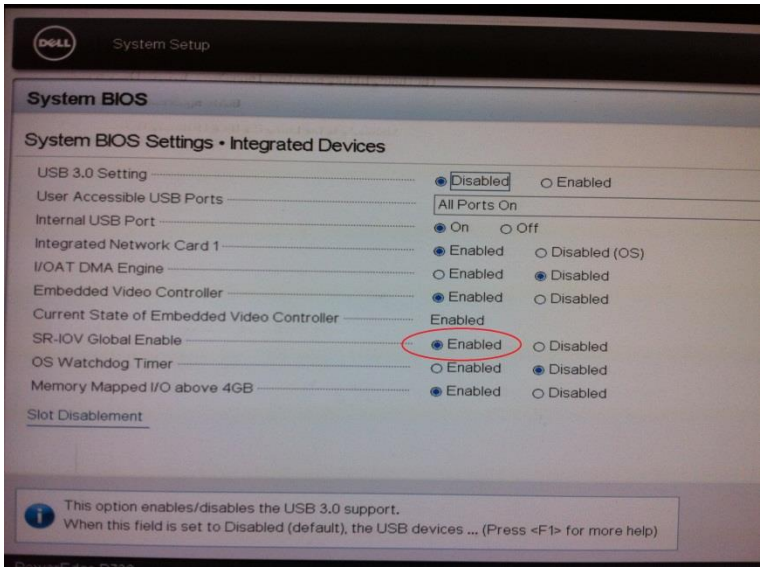
If there is an “Above 4G Decoding” enable it.
Example Path : Advanced ➔ PCI Subsystem Settings ➔ Above 4G Decoding

- **Server (Chipset (root port / bridge)) supports more than 4G address space**

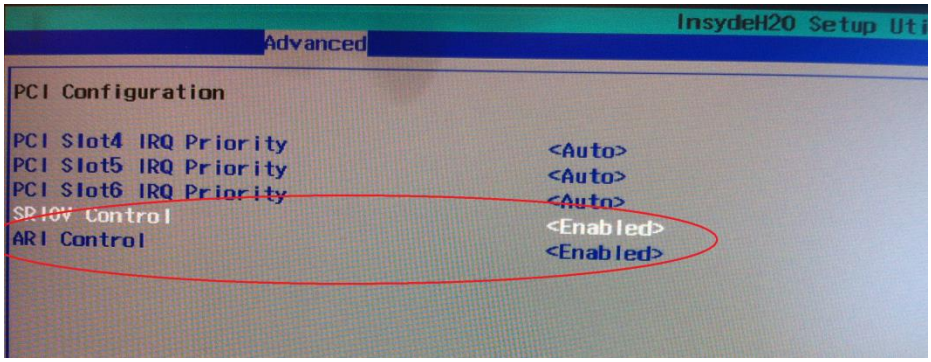
There may be an option “MMIO High Size” for this function (default may be 256G).
Example Path : IntelRCSetup ➔ Common RefCode Configuration ➔ MMIO High Size

Examples on the next page demonstrate implementations from other system BIOS vendors.

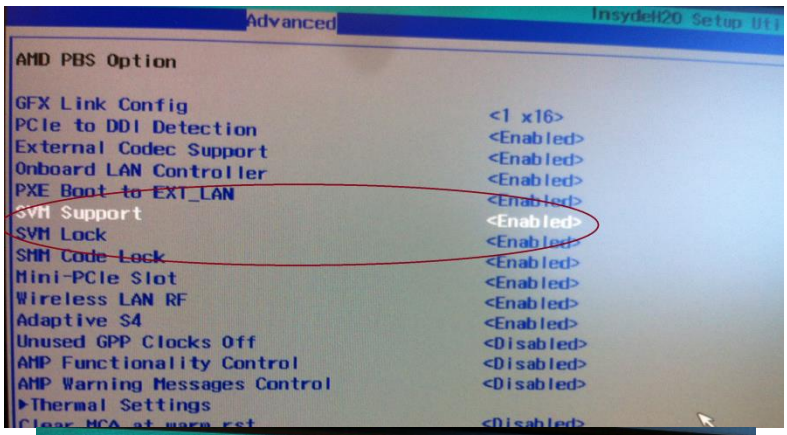
The following example shows how to enable SR-IOV on a Dell R730 platform.

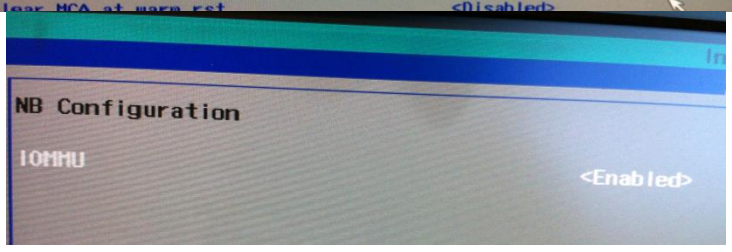


On some platforms, the SBIOS configuration page provides more options to control the virtualization behavior. One of these options is the ARI (alternative reroute interface) as shown below.



In addition, some platforms also provide controls to enable/disable SVM and/or IOMMU capability. These options must be enabled on the platform.





5.2 Manual Installation for GPUV Driver for VMware ESXi

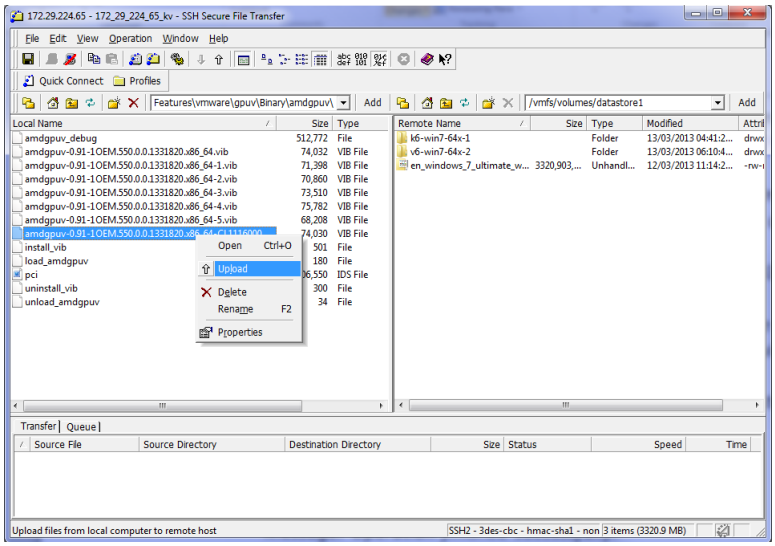
***note that the GPUV driver refers to the vib driver.**

5.2.1 Upload GPUV Driver

1. Download the GPUV driver to the administrator system from **Table 1**.

2. Start SSH Secure File Transfer utility and connect to the host server.

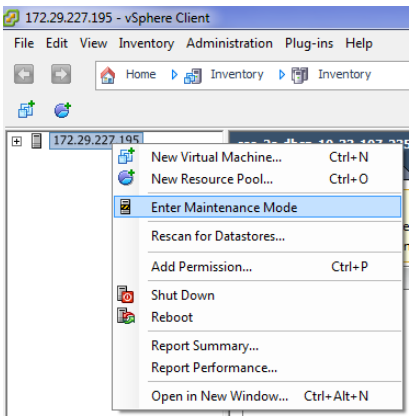
3. On the left (the administrator system), navigate to the directory where the GPUV driver is saved; on the right (the host system), navigate to **/vmfs/volumes/datastore1**



4. Right click on the GPUV driver file and select “Upload” to upload it to /vmfs/volumes/datastore1.

5.2.2 Install GPUV Driver

1. In vSphere client, place system into maintenance mode

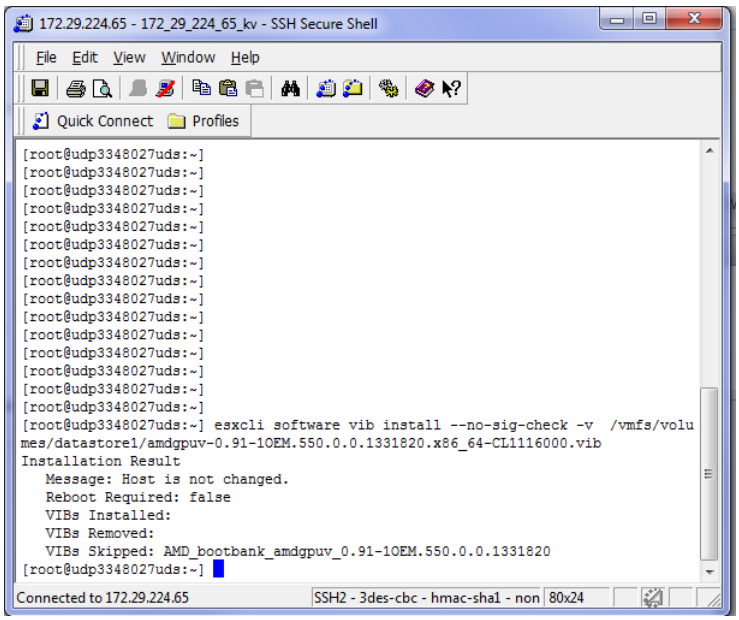


2. Start SSH Secure Shell client, connect to host, run the following command:

```
esxcli software vib install --no-sig-check -v  /vmfs/volumes/datastore1/amdgpuv-<version>.vib
```

***note : the vib name is used as an example.

You should see something this :

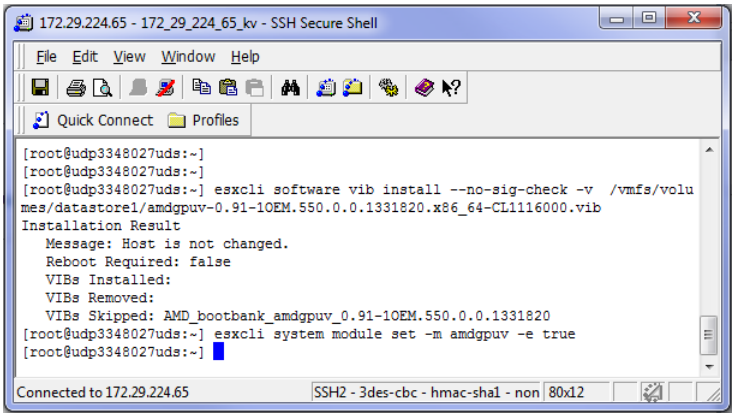


3. In the vSphere client, exit maintenance mode

4. In SSH Secure Shell client window, run the following command :

```
esxcli system module set -m amdgpuv -e true
```

This command makes the amdgpuv driver load on ESXi boot up.



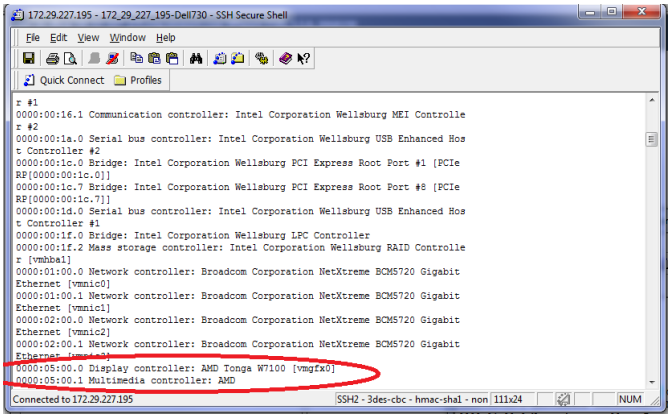
5. In vSphere client, reboot the server.

5.2.3 Configure GPUV Driver

1. Find out the BDF (bus number, device number, and function number) of the SR-IOV adapter. In SSH Secure Shell client , type in command :

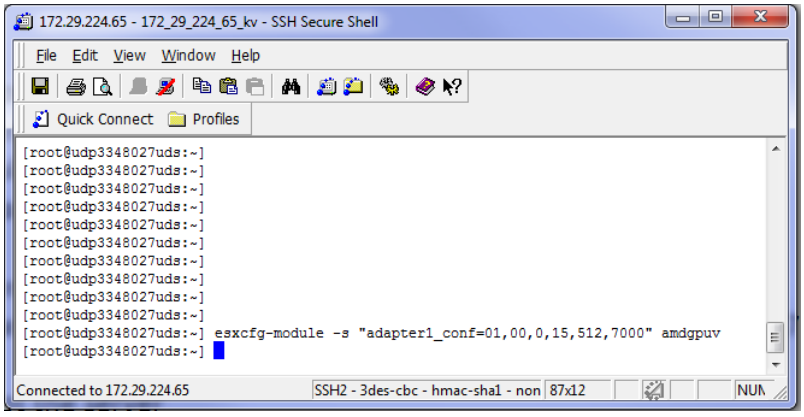
```
lspci
```

You should see something like in the picture. The BDF for this adapter is 05.00.0 in this example.



2. In SSH Secure Shell client window run the following command to specify the setting for SR-IOV adapter:

```
esxcfg-module -s ‘‘adapter1_conf=<bus>,<dev>,<func>,<num>,<fb>,<intv>’’ amdgpuv
```



The configuration is done through esxcfg-module command in the format of parameter as [bus, dev, func, num, fb, intv] to quickly set all VFs on one GPU to the same FB size and time slice.

- bus – the bus number: in decimal value
- dev – the device number: in decimal value
- func – the function number
- num – the number of enabled VFs
- fb – the size of framebuffer for each VF
- intv – the interval of VF switching.

For example,

- command: *esxcfg-module -s "adapter1_conf=1,0,0,15,512,7000" amdgpuv*

  Enables 15 virtual functions, each VF with 512M FB, and 7 millisecond time slice for switch for the adapter located @ 1.00.0

- command: *esxcfg-module -s "adapter1_conf=5,0,0,8,256,7000 adapter2_conf=7,0,0,10,256,10000" amdgpuv*
  Enable 8 VF, each VF has 256M FB and 7 millisecond time slice for adapter located @ 05:00.0
  Enable 10 VF, each VF has 256M FB and 10 millisecond time slice for adapter located @ 07:00.0

- command: *esxcfg-module -s "adapter1_conf=14,0,0,6,1024,7000 adapter2_conf=130,0,0,4,1920,7000" amdgpuv*
  Enable 6 VF, each VF has 1024M FB and 7 millisecond time slice for adapter located @ 0E:00.0
  Enable 4 VF, each VF has 1920M FB and 7 millisecond time slice for adapter located @ 82:00.0

Note:
1) Every time the command is executed, the previous configuration is overwritten. If the user wants to configure a newly added GPU, he needs to apply the previous parameter appending with new parameter in one command, otherwise the previous configuration for the existing GPU is lost.
2) If you use lspci to find out the BDF of the GPU location, the value is in hex value instead of decimal value. In the last example, the first adapter is located at bus 14, but the lspci will show as 0E:00.0; the second adapter is located at bus 130, the lspci will show as 82:00.0.

3. In order to let the new configuration take effect, a server reboot is needed - in vSphere client, reboot the server.

5.2.4 Un-Install GPUV Driver

1. Unload the GPUV driver by typing in command in SSH Secure Shell client :

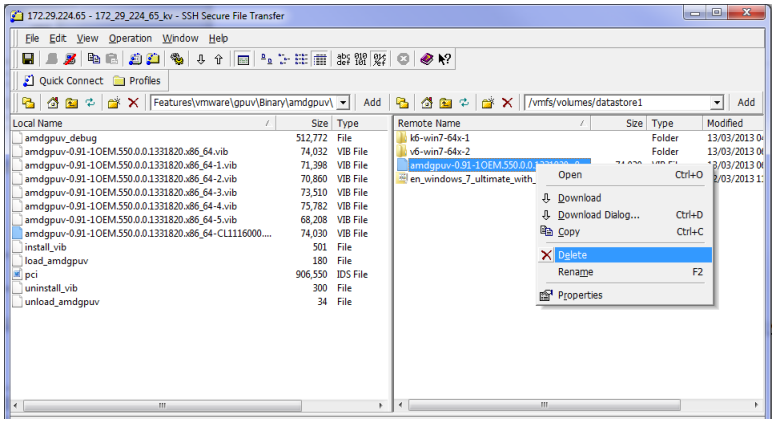
```
vmkload_mod -u amdgpuv
```

2. In vSphere Client, set system to maintenance mode

3. In SSH Secure Shell client type in command :

```
esxcli software vib remove -n amdgpuv
```

4. Start SSH Secure File Transfer utility, connect to host server. On the right (the host system), navigate to /vmfs/volumes/datastore1, select the amdgpuv driver, right click, select “Delete”.



5. In vSphere client, reboot the server.

5.2.5 Update GPUV Driver

1. Follow the sequence in section **5.2.4** to remove the old driver.
2. Follow the sequence in section **5.2.1** to download the new driver
3. Follow the sequence in section **5.2.2** to install the new driver
4. Follow the sequence in section **0** to configure the new driver.