

VMware Virtual Dedicated Graphics Accelerator (vDGA) and DirectPath I/O GPU Device Certification Guide

ESXi 6.5

GA Release

Workbench 3.5.7

This document supports the version of each product listed and supports all subsequent versions until the document is replaced by a new edition. To check for more recent editions of this document, see <http://www.vmware.com/support/pubs>.

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About This Book

This guide provides information about the tests that partners need to run to certify eligible server platforms with supported GPU devices. Each certification tests the GPU pass-through capability on the target server platform, using supported GPU devices and Guest Operating Systems. This guide provides the following:

- An overview of the certification process
- Installation and configuration procedures required to prepare for the tests
- List of tests and procedures
- Final checklists and procedures for submitting the test results

Intended Audience

This guide is intended for VMware partners who want to certify to claim compatibility in the VMware Compatibility Guide (VCG). The certification process requires familiarity with VMware ESXi, associated network/storage concepts, and the Test Manager and Installation Helper components of the most current version of Workbench.

How This Guide Is Organized

This guide contains the following information:

- **Introduction**—an overview of the testing process
- **Testbed setup**—how to configure hardware and software for testing
- **Automated tests**—list of tests to execute for certification
- **Submission**—required items that you must submit to VMware to complete your certification

Non-Disclosure Agreement Requirement

If you are a VMware partner, before you can read or use the information in this guide make sure that you have signed authorized VMware Non-Disclosure Agreement (NDA). As a reader of this guide, you accept all responsibilities in protecting all VMware confidential content revealed in this document.

VMware Infrastructure Documentation

The VMware Infrastructure documentation consists of the combined VMware vCenter and ESXi documentation set. To access VMware documentation, go to <http://www.vmware.com/support/pubs>.

VMware Workbench Documentation

Server certification program information and some VMware Workbench documentation can be accessed from the **Developer Center** (<https://developercenter.vmware.com/web/dp/home>). Please review the material on this site before beginning certification.

It is strongly recommended that you review these **VMware Workbench** guides prior to setting up your testbed and running tests:

- **Installation Helper Guide** - for details on using Installation Helper during testbed setup
- **VMware Workbench User's Guide** - for information on using the Test Manager feature to run certifications

VMware Technical Publications Glossary

VMware Technical Publications provides a glossary of terms that might be unfamiliar to you. For definitions of terms as they are used in VMware technical documentation go to <http://www.vmware.com/support/pubs>.

Certification ID

To certify Server platforms with supported GPU devices for vDGA and DirectPath I/O on ESXi, you need a certification ID.

Technical Support

To obtain technical support for tests in this guide, go to <http://www.vmware.com/go/service-request> and file a Service Request (SR).

Introduction

Virtual Dedicated Graphics Acceleration (vDGA) and DirectPath I/O allow guest operating systems to directly access an I/O device, bypassing the virtualization layer. This direct path, or pass-through can improve performance for VMware guest systems for I/O devices.

VMware requires that you certify with each Graphics Processing Unit (GPU) that you plan to support with the target server platform. A separate submission should be made for each platform and GPU combination and for each type of support (vDGA or DirectPath I/O).

vDGA GPU Certification Program

This certification program certifies eligible server platforms with supported GPU devices along with VMware Horizon View Client (used for accessing display console of the pass-through virtual machine under test).

Using this certification kit, you can certify GPU devices with one of the following guest operating systems:

- **Windows Guest Operating Systems**

If you choose to certify with Windows, make sure that you go through [“Topology for Windows”](#) on page 11 and [“Configuring Windows Virtual Machines”](#) on page 14.

- **Linux Guest Operating Systems**

If you choose to certify with Linux, make sure that you go through [“Topology for Linux”](#) on page 12 and [“Configuring Linux Virtual Machines”](#) on page 16.

- **Both Windows and Linux Guest Operating Systems**

If you choose to certify for both Windows and Linux guest operating systems, select the appropriate option from the Workbench user interface.

DirectPath I/O GPU Certification Program

This certification program certifies eligible server platforms with supported GPU devices for DirectPath I/O.

Make sure that you go through [“Topology for DirectPath I/O”](#) on page 12 and [“Configuring Linux Virtual Machines”](#) on page 16 before setting up the testbed.

Certification Test Process

The certification test process is as follows.

- 1 Ensure that the server to be used in the certification is listed in the VMware Compatibility Guide (VCG).
 - a If the server is not listed in the VCG, the server must first pass the Standard Server Certification. See <http://vmware.com/partners/partners.html> for more information about the server certification.
 - b Note that the Standard Server certification requires the third party test suite (VT-d tests) be conducted on the platform to be certified. If necessary, these may be obtained from your AMD or Intel representative. Any problems related to these tests should be directed to Intel or AMD.
 - c After successfully completing the server certification and the third party tests, fill out the submission form.
- 2 Obtain a certification ID from VMware.
- 3 Download and install the most current version of Workbench and review the documentation.
- 4 Set up the hardware and software as described in this guide.
- 5 Run the certification tests from Workbench.

Upon successful completion of the tests, submit results as described in this guide.

NOTE You can run the Standard Server Certification tests and the vDGA and DirectPath I/O GPU Device Certification tests on separate setups in parallel. For more information and assistance, contact your VMware representative.

Hardware and Software Requirements

The sections below detail the hardware and software that are required to complete the tests outlined in this guide.

Hardware Requirements

Eligible server platforms are those with VT-d or AMD IOMMU enabled. These platforms must already have been certified with the standard server certification. See <http://vmware.com/partners/partners.html> for more information.

To run the vDGA or DirectPath I/O for GPU certification, the following hardware is required:

- Servers with Compatible Power and PCI Slot Capacity.
- Physical Host Size

Many high-end GPU cards are full height, full length, and double width (taking up two slots on the motherboard, but using only a single PCIe x16 slot). Verify that the host has enough room internally to hold the chosen GPU card in the appropriate PCIe slot.

- PCIe x16 is required for all supported highest-end GPU cards.
- Host PSU (Power Supply Unit)

Check the power requirements of the GPU to make sure the PSU both is powerful enough and contains the proper power cables to power the GPU.

- Virtual Technology for Directed I/O (VT-d)

To use vDGA or DirectPath I/O, verify that the host supports either Intel VT-d (Virtualization Technology for Directed I/O) or AMD IOMMU (input/output memory management unit)

- Two-Display Adapters

If the host does not have an onboard graphics adapter, VMware recommends that you install an additional low-end display adapter to act as your primary display adapter. This is because the ESXi console display adapter is not available to Xorg. If the high-end graphics card is set as the primary adapter, Xorg will not be able to use the GPU for rendering.

If you have two GPUs installed, the server BIOS may give you the option to select which GPU should be the Primary and which should be the Secondary. If this option is available, make sure the standard GPU is set as Primary and the high-end GPU is set as Secondary

- **For vDGA only** - Separate Windows/Linux system capable of running VMware Horizon View Client 3.4 or higher.

Software Requirements

The following software is required:

- ESXi Server 6.5.
- vSphere Client 6.5.
- View Agent 7.x.
- View Agent Direct-Connection plugin (available through VMware for TESTING ONLY).
- VMware Horizon View Client 4.x (available at www.vmware.com/go/viewclients).
- Graphics software. For more information, see the VMware Horizon View Client Test details in “Functional Tests” on page 19.
- Video Capturing software, installed on the system where VMware Horizon View Client is installed.
- Appropriate display drivers - supplied and supported by GPU vendors.
- VMware Horizon environment - VMware Horizon 7.0 or a later release.

Guest Operating Systems

The following guest operating systems will be needed. Note that not all guest operating systems will be required for every GPU device. Check with the GPU vendor to determine which guest operating systems and drivers are supported for the specific GPU to be tested.

vDGA:

- Windows 7 (64-bit)
- Windows 8 (64 bit)
- Windows 8.1 (64-bit)
- RHEL 6.6 (64-bit)

DirectPath I/O:

- RHEL 5.5 (64 bit)
- RHEL 6.1 (64 bit)
- RHEL 6.2 (64 bit)
- SLES 11 (64 bit)

Virtual Machine Configuration Settings

Configure the following settings when creating a virtual machine. These settings are applicable for both Windows and Linux guest operating systems.

- Two virtual CPUs (vCPUs)
- A minimum of 4 GB RAM

- 12 MB of video memory (vRAM)

License Requirements

You must have licenses for the operating systems and software listed above.

Network Setup

To run the certification tests, it is recommended that you configure a public test network as outlined in the following section.

Setting Up the Test Network(s)

DHCP on the Public Network — The test suite requires a DHCP server on the public network, as virtual machines created during testing need to acquire IP addresses using DHCP. The test systems themselves can have static IP addresses, if desired, but DHCP must be available on the public network.

Static IP Addresses on the Public Network — If you are using static IP addresses for the systems on public network, add the static IP addresses and the host names of all participating peers, in the respective `/etc/hosts` file. If the peer addresses are not in the `/etc/hosts` file, connections between the machines will fail.

Sample network information:

```
$host1 : hostname = host1.eng.ihv.com: ip addr = 10.1.1.1
```

```
$host2 : hostname = host2.eng.ihv.com: ip addr = 10.1.1.10
```

Setting Up the Testbed

This chapter covers how to set up and configure your system before you begin the testing process. The remainder of this document assumes that you completed this setup process.

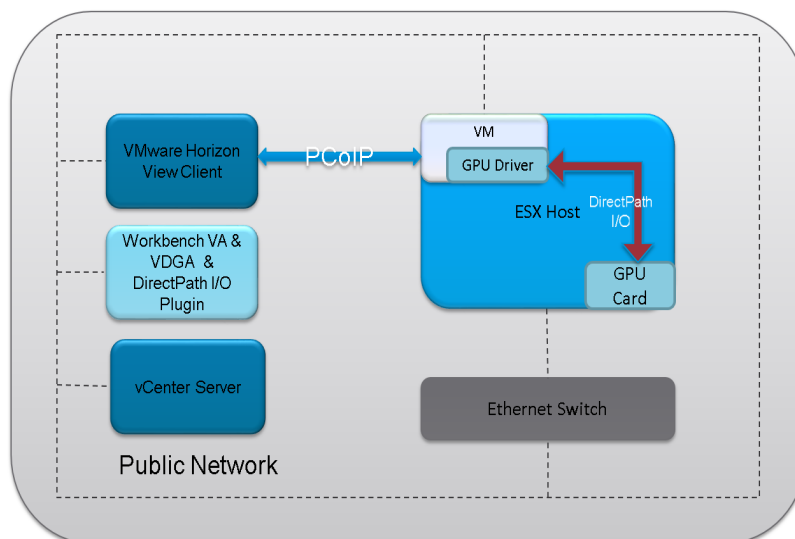
Testbed Topology

The following are the testbed topologies for Windows and Linux guest operating systems.

Topology for Windows

Figure 2-1 illustrates the vDGA testbed topology for Windows guest operating systems.

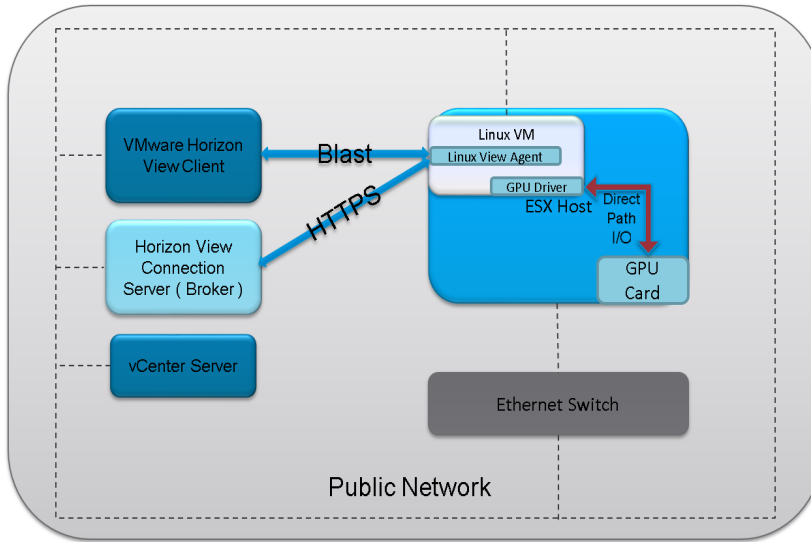
Figure 2-1. Testbed Topology for vDGA Certification for Windows



Topology for Linux

Figure 2-2 illustrates the vDGA testbed topology for Linux guest operating systems.

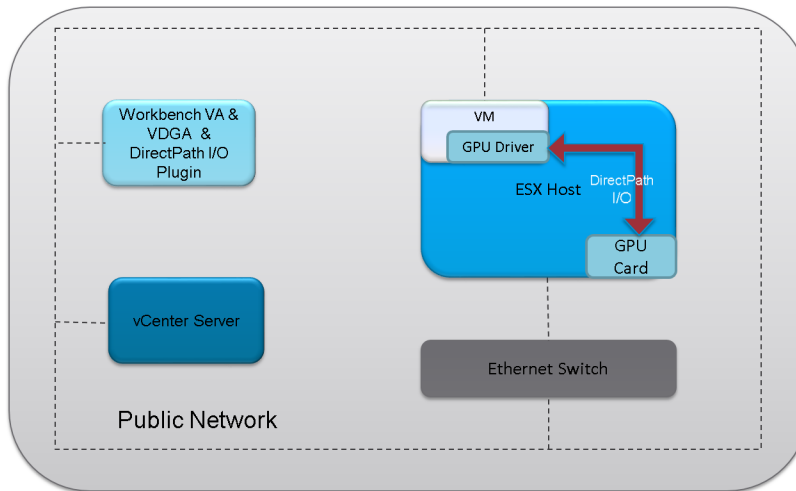
Figure 2-2. Testbed Topology for vDGA Certification for Linux



Topology for DirectPath I/O

Figure 2-3 illustrates the DirectPath I/O testbed topology for Linux guest operating systems.

Figure 2-3. Testbed Topology for DirectPath I/O for Linux



Installing Workbench

Workbench is used to run the certification tests. To install Workbench, see the *VMware Workbench User's Guide*. Ensure that you are using the most current version of Workbench. Use the default user name (**root**) and password (**vmware**) to log in to Workbench for this certification.

NOTE Before you download the certification plug-in and install into Workbench, ensure that you have more than 2GB free space available in Workbench; otherwise the installation will fail.

Login Information for ESXi hosts/vCenter Server

To avoid disclosing confidential passwords, VMware recommends that you use the following usernames and passwords for certification testing.

ESXi:

login: **root**

password: **Admin!23**

vCenter Windows:

login: **administrator@vsphere.local**

password: **Admin!23**

vCenter VCSA:

login: **administrator@vsphere.local**

password: **Admin!23**

Installing and Configuring ESXi

Before running tests, you must install ESXi on the machines under test. For information on how to install ESXi, see *ESXi Installation Guide*.

- 1 After the ESXi host boots, press F2 to enter the **Customize System** menu.
- 2 Select the **Troubleshooting Mode Options** sub-menu to enable ESXi Shell and SSH.
- 3 Run the following command to disable the firewall:


```
# esxcli network firewall set -e false
```
- 4 Enable the Host for GPU Pass-Through from the host to the virtual desktop.

Before you enable GPU Pass-Through, check the server BIOS to make sure that VT-d or AMD IOMMU is enabled on the ESXi host. For more information about finding the VT-d or AMD IOMMU settings in your server BIOS, contact your hardware vendor.
- 5 Enable Device Pass-Through on the ESXi host.
 - a Using the vSphere client, connect to vCenter and select the host with the GPU card installed.
 - b Select the **Manage** tab for this host.
 - c Expand the **Hardware** group and click **PCI Devices**.
 - d Right-click on one of the GPUs installed in the system and click **Edit**.
 - e In the **Edit PCI Device Availability** window, select the checkbox or boxes that correspond to the GPU adapters you want to use for pass-through.
 - f Click **OK**. The GPU should now be listed in the window on the **Advanced Settings** page.
- 6 On Workbench, install STAF on ESXi using Installation Helper: under **VMware > Open Installation Helper View**, right-click the target host and select **Install STAF**.

Configuring Virtual Machines

The vDGA and DirectPath I/O tests require installing a virtual machine on the host.

- If you are running a virtual machine with Windows guest operating system, see [“Configuring Windows Virtual Machines”](#) on page 14.
- If you are running a virtual machine with Linux guest operating system, see [“Configuring Linux Virtual Machines”](#) on page 16.

Configuring Windows Virtual Machines

- 1 Install the virtual machine running Windows 7 (64-bit) or Windows 8.1 (64-bit) on the host system. Ensure that the virtual machine hardware is version 11 for ESXi 6.0, and the network adapter type is VMXNET3.

NOTE Ensure that the virtual machine name does not have blank spaces. For example, the correct name format is `vm_1`. The incorrect name format is `vm 1`. A blank space in the virtual machine name may cause the tests to fail.

- 2 If you are prompted to create a user account when you are installing the virtual machine, ensure that the account name is `test`, and create a password for the test account. If you are not prompted, power on the virtual machine and create the `test` account and password.

Perform the following steps to ensure that the `test` account has the auto-logon feature enabled:

- a Click **Start > Run**.
 - b In the **Run** window, type `control userpasswords2` and click **OK**.
 - c Deselect the **Users must enter a user name and password to use this computer** check box and click **Apply**.
 - d In the **Automatically Log On** window, enter the password that you created for the test account.
 - e Click **OK** to close the **Automatically Log On** window, and then click **OK** to close the **User Accounts** window.
- 3 Disable the firewall.
 - 4 Perform the following steps to disable the blank account policy (enabled by default):
 - a Click **Start > Run**.
 - b In the **Run** window, type `gpedit.msc` and click **OK**.
 - c In the Group Policy window, click **Computer Configuration > Windows Settings > Security Settings > Local Policies > Security Options**.
 - d Double-click **Accounts: Limit local account use of blank passwords to console logon only**.
 - e Select **Disabled** and click **OK** to close the **Automatically Log On** window, and then click **OK** to close the **User Accounts** window.
 - f Click **File > Exit** to close the Group Policy window.
 - 5 Disable User Account Control (UAC) - go to **Control Panel -> User Accounts -> Change User Account Control Settings**. Drag the slider to **Never notify** and click **OK**.
 - 6 Install VMware tools corresponding to the host system's ESXi build number and version using the Next Generation Client:
 - a Right-click the virtual machine and select **Guest > Install/Upgrade VMware Tools**.
 - 7 Perform the following steps to disable sleep mode in the guest operating system:
 - a Click **Start > Control Panel > Hardware and Sound > Power Options**.
 - b Click **Change when the computer sleeps**.
 - c Select **Never** for **Turn off the display** and **Put the computer to sleep** settings.
 - d Click **Save Changes** and close all the windows.
 - 8 Perform the following steps to disable the **Windows Update** feature on the virtual machine:
 - a Click **Start > Run**, type `services.msc`.
 - b In the **Services** window, look for the **Windows Update** entry in the right pane.
 - c Double-click this entry and in the window that opens, **Stop** the service.

- d Set startup type as **Disabled**.
 - e Click **OK** to validate.
- 9 Perform the following steps to run the administrator account in **Admin Approval** mode:
- a Click **Start > Run**.
 - b In the **Run** window, type `secpol.msc` and click **OK**.
 - c Click **Security Settings > Local Policies > Security Options > User Account Control: Run all administrators in Admin Approval Mode**.
 - d Change the **Local Security Setting** to **Disabled**, and click **OK**.
- 10 On Workbench, install STAF on the virtual machine using Installation Helper:
- a Under **VMware > Open Installation Helper View**, expand the host to see the registered virtual machines, right-click the virtual machine and select **Install STAF**.
 - b On the virtual machine console, click **Run vmwb-staf.bat** when the STAF installer CD autoplay pops-up.
 - c Run the installation to completion.

To enable a virtual machine for GPU pass-through, follow the checks and steps in the following section.

- 11 Adjust `pciHole.start`.

NOTE This is required only if the virtual machine has more than 2GB of configured memory.

For virtual machines that have more than 2GB of configured memory, add the following parameter to the `.vmx` file of the virtual machine (you can add this at the end of the file):

```
pciHole.start = "2048"
```

- 12 Add the PCI device.

To enable a virtual machine for GPU pass-through, the PCI device must be added to the virtual machine's hardware.

- a Using the vSphere Web Client, connect directly to the ESXi host that has the GPU card installed, or select the host in vCenter.
 - b Right-click the virtual machine and select **Edit Settings**.
 - c From the **New Device** drop-down menu at the bottom of the window, select **PCI Device**.
 - d Click **Add**.
 - e Select the appropriate PCI device from the drop-down menu.
 - f If prompted, click **Reserve All Memory**.
 - g Click **OK**.
- 13 **For vDGA only:** Install View Agent on the virtual machine and reboot when prompted.
- 14 **For vDGA only:** Install the View Agent Direct-Connection plugin (available through VMware for TESTING ONLY).
- 15 **For vDGA only:** Install the Graphics driver.
- a Download the latest Graphics driver and install it on the virtual machine. (All drivers can be downloaded from the GPU vendor's Drivers Download page.)
 - b After the driver is installed, reboot the virtual machine.
- 16 **For vDGA only:** Check that the virtual machine is using the GPU and installed graphics driver.

In order to activate the display adapter, you must connect to the virtual machine for the first time via PCoIP in full screen from the endpoint (at native resolution), or the virtual machine will use the Soft display adapter. Virtual Dedicated Graphics Acceleration (vDGA) does not work through the vSphere console session. See “[VMware View Horizon Client Setup \(vDGA ONLY\)](#)” on page 18 for details.

- 17 **For vDGA only:** After the virtual machine has rebooted and you have connected via PCoIP in full screen, check to ensure that the GPU is active by viewing the display information in DXDiag.exe:
 - a Click the **Start** menu.
 - b Type `dxdiag` and click **Enter** after DxDiag shows up in the list, or click on it in the list.
 - c After DxDiag launches, check the **Display** tab to verify that the virtual machine is using the GPU and driver.
- 18 Power off the virtual machine.
- 19 Make sure that the system time of every virtual machine’s guest operating system is set to the same time as the ESXi host and the vSphere Client system.

Configuring Linux Virtual Machines

- 1 Install the virtual machine running Red Hat Enterprise Linux (RHEL) 6.6 (64-bit) on the host system. Ensure that the virtual machine hardware is version 11 for ESXi 6.0, and the network adapter type is VMXNET3.

NOTE Ensure that the virtual machine name does not have blank spaces. For example, the correct name format is `vm_1`. The incorrect name format is `vm 1`. A blank space in the virtual machine name may cause the tests to fail.

- 2 Create a root account for the virtual machine and use this account for running the certification tests.
- 3 Disable the firewall.
- 4 Install VMware tools by performing the following steps:
 - a In vSphere Web Client or vSphere Client, mount the VMware Tools virtual disk on the guest operating system.
 - b Right-click the VMware Tools installer file `VMwareTools.x.x.x-xxxx.tar.gz`, click **Extract to**, and select the desktop for your Linux distribution. The `vmware-tools-distrib` folder is extracted to the desktop.
 - c In the virtual machine, log in to the guest operating system as `root` and open a terminal window.
 - d Run the installer and configure VMware Tools by using the following command. This command may vary slightly across different Linux distributions.


```
cd vmware-tools-distrib
sudo ./vmware-install.pl -d
```

The `vmware-config-tools.pl` configuration file runs after the installer file completes execution.
- 5 Configure the Linux virtual machine to be resolvable through DNS.
- 6 Ensure that the View Connection Server instances in the pod are resolved through DNS.
- 7 Install JRE on the Linux VM. For information on the required JRE versions, see *Required JRE Versions for Linux Guest Operating Systems* in the *Setting Up Horizon 6 for Linux Desktops* guide at <http://www.vmware.com/support/pubs>.
- 8 Perform the following steps to Install STAF:
 - a Download the `STAFxxx-linux-amd64.tar.gz` file from <http://staf.sourceforge.net/getcurrent.php>.
 - b Open a terminal in the folder where the file is downloaded and run the following commands:


```
tar -xzf STAFxxxx-linux-amd64.tar.gz
```

```
cd staf
```

```
./STAFInst
```

- c Append 'trust default level 5' to the STAF.cfg file in /usr/local/staf/bin.
 - d Add the following information to the /root/.bash_profile file:


```
PATH=$PATH:$HOME/bin:/usr/local/staf/bin
export PATH
LD_LIBRARY_PATH=/usr/local/staf/lib:$LD_LIBRARY_PATH
export LD_LIBRARY_PATH
STAF_INSTANCE_NAME=STAF
export STAF_INSTANCE_NAME
```
 - e Create a file called startstaf.conf at /etc/init/ and add the following information:


```
expect daemon
exec /usr/local/staf/startSTAFProc.sh
start on stopped rcS
```
 - f Reboot the VM.
- 9 Adjust pciHole.start.

This step is applicable only if your virtual machine has more than 2GB of configured memory:

 - a Add the following parameter at the end of the .vmx file of the virtual machine: pciHole.start = "2048"
 - 10 Perform the following steps to add the PCI device to the virtual machine, so that GPU pass-through for that virtual machine is enabled:
 - a Using the vSphere Web Client, connect directly to the ESXi host that has the GPU card installed, or select the host in vCenter.
 - b Right-click the virtual machine and select **Edit Settings**.
 - c From the **New Device** drop-down menu at the bottom of the window, select **PCI Device**.
 - d Click **Add**.
 - e Select the appropriate PCI device from the drop-down menu.
 - f If prompted, click **Reserve All Memory**.
 - g Click **OK**.
 - 11 **For vDGA only:** Install View Agent. For information on installing View Agent, see *Install View Agent on a Linux Virtual Machine* in the *Setting Up Horizon 6 for Linux Desktops* guide at <http://www.vmware.com/support/pubs>.
 - 12 **For vDGA only:** Install the Graphics driver. For information on installing the Graphics driver, see *Install an NVIDIA GRID Driver on RHEL 6.6* in the *Setting Up Horizon 6 for Linux Desktops* guide at <http://www.vmware.com/support/pubs>.
 - 13 Power off the virtual machine.
 - 14 Make sure that the system time of every virtual machine's guest operating system is set to the same time as the ESXi host and the vSphere Client system.

VMware View Horizon Client Setup (vDGA ONLY)

On a separate system, download and install the VMware Horizon View client (available from www.vmware.com/go/viewclients). Use the VMware Horizon View client to connect to the Name/IP Address of the virtual machine under test that has the graphics card assigned to it.

After setting up the host, VMs, and the View Client, run the tests as described in this document.

3

Running Tests

Use Workbench to run these tests. See the *VMware Workbench User's Guide* for details.

Functional Tests

VM Piglit Test (Automated)

OpenGL Driver Testing Framework on a high level covers functionalities such as FBO, Glean, ARBfp, ARBvp, GLSL, GLX, GLParser, Mesa, Shaders, Textures, and so on.

VMware Horizon View Client Test (Manual)

For Windows

This test is designed to test the GPU pass-through functionality on a server platform while viewing the pass-through VM console using VMware Horizon View Client.

To run this test:

- 1 Start the video capture program on the client system with VMware Horizon View Client installed, in full screen mode, using a common video format (.avi, .wmv, .mpg, and so on). Ensure that the time and date of the system is showing.
- 2 On the client system with VMware Horizon View Client, capture the following information on the VMware vSphere Web Client:
 - a Host system information summary - In the VMware vSphere Web Client, select the Host and click the **Summary** tab.
 - b VM Summary - In the VMware vSphere Web Client, select the virtual machine under test on the Host, and click the **Summary** tab.
- 3 On the VMware Horizon Client, open the **About VMware Horizon Client** page and click **OK**.
- 4 Connect to the pass-through virtual machine using VMware Horizon View Client.
- 5 On the Pass-through virtual machine, go to **Control Panel > Programs > Programs and features** and select the VMware Horizon View Agent that is installed on the virtual machine.
- 6 Download and install the Unigine Heaven application on the pass-through virtual machine.
- 7 Start the Unigine Heaven Benchmark application.
 - a Select **OpenGL** as the API.
 - b Deselect the **Full Screen** mode option.
- 8 Select the **Benchmark** option on the Application after the rendering starts. Save the report that is generated at the end.

- 9 Submit the test results along with the videos.

For Linux

To run this test:

- 1 Start the video capture program on the client system with VMware Horizon View Client installed, in full screen mode, using a common video format such as .AVI, .WMV, or .MPG. Ensure that the system time and date is updated.
- 2 On the client system with VMware Horizon View Client, capture the following information on the VMware vSphere Web Client:
 - a Host system information summary - In the VMware vSphere Web Client, select the Host and click the **Summary** tab.
 - b VM Summary - In the VMware vSphere Web Client, select the virtual machine under test on the Host, and click the **Summary** tab.
- 3 On the VMware Horizon Client, open the **About VMware Horizon Client** page and click **OK**.
- 4 Login and connect to the View connection server.
- 5 Navigate to **Catalog > Desktop Pools** and select a **Horizon View desktop pool**.
- 6 Click the **Inventory** tab. The virtual machine name and agent version with other details are displayed.
- 7 Download and install the Unigine Heaven application on the pass-through virtual machine.
- 8 Start the Unigine Heaven Benchmark application:
 - a Select **OpenGL** as the API.
 - b Select the **Full Screen** mode option.
- 9 Select the **Benchmark** option on the application after the rendering starts. Save the report that is generated at the end.
- 10 Submit the test results along with the videos.

Stability Tests (Automated)

VM Power Off - While running device functional test workloads, the virtual machine is powered off. The host should not PSOD.

Reset VM - While running device functional test workloads, the virtual machine is reset. The host should not PSOD.

VM Powercycle - Powercycles the virtual machine while running device functional test workloads. The host should not PSOD.

Kill VM - While running device functional test workloads, the virtual machine is killed. The host should not PSOD.

Test Results Submission

Submit test results using Workbench. See the *VMware Workbench User's Guide* for details.