



# NVIDIA GRID™ VGPU™ DEPLOYMENT GUIDE FOR VMWARE HORIZON 6.1

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### Dedications:

To Erin, my wife, for patience beyond measure, and LBG for thinking baby typing would help the flow and get it done quicker. – Luke

To my lovely wife, my incredible son, and my incredibly small dog. – Jeff

## FOREWORD

I have had the pleasure of working closely with Luke, Jeff, and rest of the NVIDIA® GRID™ team to bring NVIDIA® GRID™ vGPU™ to VMware Horizon users.

Together, VMware Horizon with NVIDIA® GRID™ vGPU™ solve the most challenging use case for virtual desktops, running the most advanced, graphics-rich applications in a remote desktop – using NVIDIA® professional 3D graphics with certified application drivers. Designers, architects and engineers are excited to experience workstation-class performance even in remote offices over high-latency networks.

The NVIDIA® GRID™ vGPU™ Deployment Guide for VMware Horizon 6.1 is an essential resource in getting up and running with VMware Horizon and NVIDIA® GRID™ vGPU™. From basic installation to sizing your environment for complex graphics rich applications, the vGPU™ deployment guide will make you and your users more successful.

I look forward to hearing about your experience and success after deploying VMware Horizon with NVIDIA® GRID™ vGPU™ based on this most excellent deployment guide.

Pat Lee  
Senior Director, Remote Experience  
VMware

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# Chapter 1.

## ABOUT THIS DOCUMENT

This section contains an overview of the chapters, the formatting conventions and information contained in this deployment guide. There is also a quick list of acronyms used. Lastly, we detail the lab environment used to test the contents of this guide and capture the screenshots used.

### 1.1 ORGANIZATION

This manual contains the following chapters:

- ▶ Chapter 1 – About this Document: Explains the conventions used in this document, related documentation, contact information, and a list of acronyms.
- ▶ Chapter 2 – Getting Started: Introduces you to NVIDIA GRID™ technology and guides you through preparing to deploy NVIDIA® GRID™ vGPU™ with VMware Horizon.
- ▶ Chapter 3 – vSphere 6 Installation: Guides you through preparing a bootable USB drive and installing vSphere 6 on the selected host.
- ▶ Chapter 4 – Installing VMware vCenter 6 Server: Instructions for installing and configuring VMware vCenter 6 Server, either Windows or OVA Linux virtual appliance.
- ▶ Chapter 5 – NVIDIA vGPU Manager VIB Installation: Step-by-step guide to downloading, preparing, uploading, installing, or uninstalling an NVIDIA vGPU Manager VIB file.
- ▶ Chapter 6 – Building Horizon 6.1: Instructions for installing and configuring Horizon 6.1 Broker.

- ▶ Chapter 7 – Building a vGPU vSphere Host Cluster: Adding vGPU enabled hosts to create a vGPU Cluster.
- ▶ Chapter 8 – Choosing a NVIDIA vGPU Profile: Understanding the range of available profiles and how to select the correct ones for your user groups.
- ▶ Chapter 9 – Application Based VDI Host sizing Example: ESRI ARCGIS
- ▶ Chapter 10 – Creating your first vGPU Virtual Desktop: Guides you through configuring an NVIDIA vGPU for a single guest desktop to create a template.
- ▶ Chapter 11 – Create a Horizon vGPU Pool: Using View Composer 6.1, create a Linked Clone pool of vGPU powered desktops using a single vGPU profile.
- ▶ Chapter 12 – Testing, Monitoring, & Benchmarking: Describes procedures for testing and benchmarking your NVIDIA GRID deployment.
- ▶ Chapter 13 – Known Issues: Lists known issues related to vCenter, NVIDIA, and hardware.
- ▶ Chapter 14 – Troubleshooting: Provides processes for resolving common issues.
- ▶ Chapter 15 – Using WinSCP: Describes how to perform relevant functions of this SFTP/SCP client.

## 1.2 FORMATTING CONVENTIONS

This document uses several formatting conventions to present information of special importance.

Lists of items, points to consider, or procedures that do not need to be performed in a specific order appear in bullet format:

- ▶ Item 1
- ▶ Item 2

Procedures that must be followed in a specific order appear in numbered steps:

1. Perform this step first.
2. Perform this step second.

Specific keyboard keys are bolded and capitalized, for example: **ESC**. If more than one key should be pressed simultaneously, it is displayed as **KEY1+KEY 2**, for example **ALT+F4**.

Interface elements such as document titles, fields, windows, tabs, buttons, commands, options, and icons appear in bold or italics text.

Menus and submenus have the notation **Menu→Submenu**. For example, “Select **File→Save**” means that you should first open the **File** menu, and then select the **Save** option.

Specific commands appear in standard Courier font. Sequences of commands appear in the order in which you should execute them and include horizontal or vertical spaces between commands. The following additional formatting also applies when discussing command-line commands:

Plain-text responses from the system appear in bold **Courier** font.

This manual also contains important safety information and instructions in specially formatted callouts with accompanying graphic symbols. These callouts and their symbols appear as follows throughout the manual:



**CAUTION:** Cautions alert you to the possibility of a serious error, data loss, or other adverse condition



Notes provide helpful information

## 1.3 RELATED DOCUMENTATION

Refer to <http://www.nvidia.com/gridresources> for additional information about NVIDIA GRID technology, including:

- ▶ [NVIDIA GRID vGPU](#)
- ▶ [Lists of GRID-certified servers](#)
- ▶ [Datasheet](#)
- ▶ [Guides and Solution Overviews](#)
- ▶ [Case Studies](#)
- ▶ [White Papers](#)
- ▶ [Videos](#)

## 1.4 ACRONYMS

CLI	“Command Line Interface” - as opposed to using a something graphical, this is ASCII text based interaction with an app or OS
GPU	“Graphics Processing Unit” - the physical chip that accelerates the creation of graphical imagery in frame buffer for output on a display.
GUI	“Graphical User Interface” - a visual, windowed based means of interacting with an app or OS
OS	“Operating System” - a base level installation such as Windows that controls the underlying hardware (or virtual hardware)
OVA	“Open Virtualization Appliance” - an OVF bundled into a discrete and portable appliance
OVF	“Open Virtualization Format” - portable files representing discrete virtual machines, these can be bundled into OVA packages as a discrete appliance as well
POC	“Proof of concept”
UI	“User Interface” - refers to a tool used to enter data or otherwise interact with an application or OS
vDGA	“Virtual Direct Graphics Acceleration”
VDI	“Virtual Desktop Infrastructure” - a general term for desktop operating systems running as a guest on a host server
vGPU	“Virtual Graphics Processing Unit” - a virtual GPU provided by the hypervisor and managed by the vGPU Manager to provide VM’s access to the power of a physical GPU.
vib	“vSphere Installation Bundle”
VM	“Virtual Machine” - an operating system running as a guest on a host server
vSGA	“Virtual Shared Graphics Acceleration”
WebUI	“Web User Interface” - a visual, windowed web based means of interacting with an app or OS

## 1.5 THE DEPLOYMENT GUIDE LAB

To write this guide, test the steps necessary, gather the screenshots, and research what would become the contents, we used the following equipment:

NVIDIA Lab:

- Management Cluster
  - Hosts:
    - Supermicro 1U servers, local storage, 1GB NICs
  - Guests:
    - Microsoft Windows 2012 Domain Controller
    - Microsoft SQL Server 2008

- vCenter Server Appliance (VCSA), Linux based
  - Microsoft Windows 2012 Servers for running:
    - View Composer
    - vCenter Server on Windows
- Production Cluster
  - Hosts:
    - Supermicro 2U servers, 2x NVIDIA GRID K2s, vSAN (SSD & spindle HDD), 1GB NICs, 10G NICs for iSCSI to Pure Storage SAN
  - Guests:
    - Microsoft Windows 7 Professional x64
    - Microsoft Windows 8.1
- SAN Storage
  - Pure Storage FA-420 (10G iSCSI)
- Networking
  - Arista 10G core switch
    - No LAG or similar
  - Juniper & Cisco 1GB distribution switches
- Load Generation
  - VMware View Planner 3.5
  - Login VSI
- Monitoring
  - Lakeside Systrack v7 (with GPU monitoring)

It is not necessary to have all of the equipment we used for building out your POC/trial environment; in fact it can be done on a single physical server. This is not, however, representative of a recommended enterprise deployment and can impact performance. To insure the most accurate results and performance you intend to deliver to your end users, build your POC/trial as close as possible to what it will look like once in production. Further, by separating the management and production (or virtual desktop) clusters, we were able to reinstall new versions of code while retaining foundational services and exported virtual machines.

### ***Special Thanks:***

Having access to fast cache storage allowed us to scale out and work with density to test the ability to handle greater quantities of users. We would like to thank Pure Storage for providing a SAN for us to build against, and the support of their Solution Architects who quickly brought it up and configured it. For more information see: <http://www.purestorage.com/flash-array/>



# Chapter 2.

## GETTING STARTED

NVIDIA GRID™ vGPU™ enables multiple virtual machines (VMs) to have simultaneous, direct access to a single physical GPU, using the same NVIDIA graphics drivers that are deployed on non-virtualized operating systems. This gives VMs unparalleled graphics performance and application compatibility, together with cost-effectiveness and scalability brought about by sharing a GPU among multiple workloads.

This chapter covers how NVIDIA GRID vGPU fundamentally alters the landscape of desktop virtualization and enables users and applications of all levels of complexity and graphics requirements. It also describes the NVIDIA GRID vGPU architecture, the types of virtual GPUs supported, and key standards supported by GRID vGPU.

## 2.1 WHY NVIDIA VGPU GRID?

The promise of desktop virtualization, realized for server workloads years ago, is flexibility and manageability. Initially, desktop virtualization was used where the flexibility and security were the primary drivers due to cost considerations. Over the last five years, the cost of desktop virtualization has been coming down quickly due to advances in storage and multi-core processors.

The big remaining challenge for desktop virtualization is providing a cost effective yet rich user experience. There have been attempts to solve this problem with shared GPU technologies like vSGA that are cost effective, but those technologies don't support the rich application support needed to be successful and ensure end user adoption. This compared to dedicated GPU pass-through with vDGA that does provide 100%

application compatibility, but only for the highest end use cases due to the high cost with limited density of virtual machines per host server.

Due to the lack of scalable, sharable, and cost effective per user GPUs that provide 100% application compatibility, providing a cost effective rich user experience has been challenging for broad use cases in desktop virtualization. Meanwhile, high-end 3D applications simply did not work in a virtualized environment, or were so expensive to implement with vDGA it was reserved for only the most limited of circumstances.

Today, this is no longer true thanks to NVIDIA GRID vGPU combined with VMware Horizon. NVIDIA GRID vGPU gives you the best of both worlds where multiple virtual desktops share a single physical GPU, and multiple GPUs on a single physical PCI card, all providing the 100% application compatibility of vDGA pass-through graphics, but with lower cost of multiple desktops sharing a single graphics card to provide a rich, yet more cost effective user experience. With Horizon you are able to centralize, pool, and more easily manage traditionally complex and expensive, distributed workstations and desktops. Now all your user groups can take advantage of the promise of virtualization.

## 2.2 NVIDIA GRID vGPU ARCHITECTURE

Physical NVIDIA GRID GPUs are capable of supporting multiple *virtual* GPU devices (vGPUs) that can be assigned directly to guest VMs under the control of NVIDIA's GRID Virtual GPU Manager running in VMware vSphere 6. Guest VMs use the GRID vGPUs in the same manner as a physical GPU that has been passed through by the hypervisor. An NVIDIA driver loaded into the VM's guest OS leverages direct access to the GPU for performance and critical fast paths. Non-critical performance management operations use a para-virtualized interface to the GRID Virtual GPU Manager. Figure 2-1 shows the GRID vGPU system architecture.

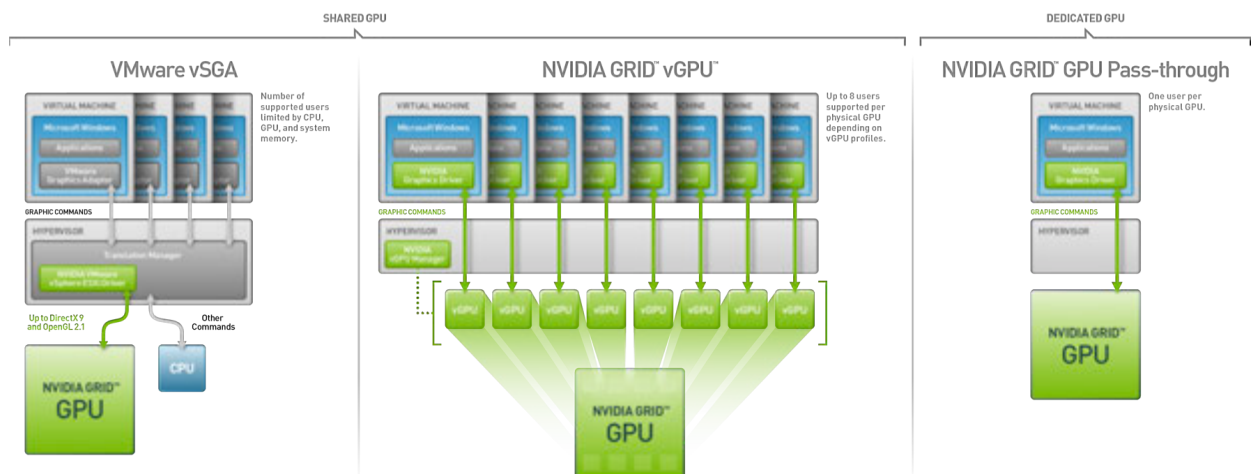


Figure 2-1. GRID vGPU System Architecture

NVIDIA GRID vGPUs are comparable to conventional GPUs in that they have a fixed amount of GPU frame buffer and one or more virtual display outputs or *heads*. Multiple heads support multiple displays. Managed by the NVIDIA vGPU Manager installed in the hypervisor, the vGPU frame buffer is allocated out of the physical GPU frame buffer at the time the vGPU is created. The vGPU retains exclusive use of that frame buffer until it is destroyed.

All vGPUs resident on a physical GPU share access to the GPU's engines, including the graphics (3D), and video decode and encode engines. Figure 2-2 shows the GRID vGPU internal architecture.

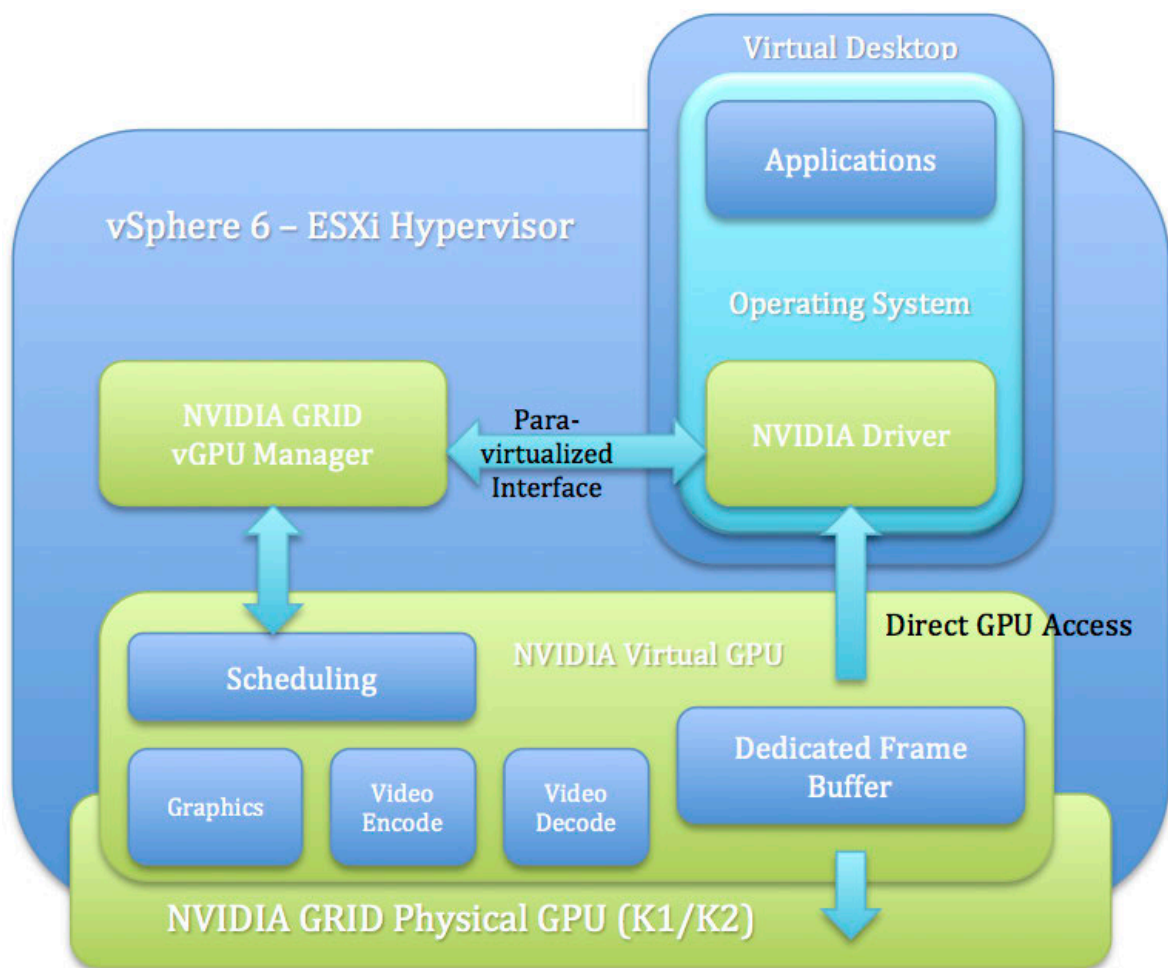


Figure 2-2. GRID vGPU Internal Architecture

## 2.3 SUPPORTED GPUS

NVIDIA GRID vGPU is supported on NVIDIA GRID K2 and GRID K1 cards. GRID K2 and K1 each implement multiple physical GPUs:

- GRID K2 has two GPUs on board, best for performance over density.
- GRID K1 has four GPUs on board, best for density over performance.

Each physical GPU can support several different types of virtual GPU (vGPU). Each of the vGPU types has a fixed amount of frame buffer, number of supported display heads and maximum resolutions, and targeted at different classes of workload. Table 2-1 lists the virtual GPU types supported by GRID K1 and K2:

Table 2-1. Virtual GPU Types

Card	Physical GPUs	Virtual GPU	Intended User(s)	Frame Buffer (MB)	Virtual Display Heads	Max Resolution	Maximum vGPUs	
							Per GPU	Per Board
GRID K2	Two	GRID K280Q	Designer	4096	4	2560x1600	1	2
		GRID K260Q	Designer	2048	4	2560x1600	2	4
		GRID K240Q	Power User	1024	2	2560x1600	4	8
		GRID K220Q	Power User	512	2	2560x1600	8	16
GRID K1	Four	GRID K180Q	Power User	4096	4	2560x1600	1	4
		GRID K160Q	Power User	2048	4	2560x1600	2	8
		GRID K140Q	Knowledge Worker	1024	2	2560x1600	4	16
		GRID K120Q	Knowledge Worker	512	2	2560x1600	8	32

The maximum number of vGPUs that can be created simultaneously on a physical GPU is eight, and each GPU has 4GB of frame buffer memory. Your selection of a profile defines the amount of graphics frame buffer assigned per guest virtual desktop and thus how many virtual desktops can share that physical GPU. For example, a GRID K2 physical GPU can support up to four K240Q vGPUs on each of its two physical GPUs (for a total of eight vGPUs), but only two K260Qs vGPUs (for a total of four vGPUs). You cannot oversubscribe frame buffer and it must be shared equally for each physical GPU, but you can select different profiles for each GPU. As a result a K2 card, with its two physical GPUs can support up to two different profiles, each K1 can support up to four. See *Homogeneous Virtual GPUs* for more detail.

The K2 and K1 are full height, full length, double width PCI-e cards, and are passively cooled (no onboard fan) requiring certified servers designed to properly power and cool them. Refer to <http://www.nvidia.com/buygrid> for a list of recommended server platforms

to use with GRID K1 and K2 and cross-reference the NVIDIA list against the VMware vSphere HCL for servers and find servers on both lists. This list continues to grow rapidly, check back often for more certified platforms. Each card requires auxiliary power cables connected to it, see chart below for specific pin counts, and most servers require an enablement kit for proper mounting the of the GRID cards. Check with your server OEM of choice for more specific requirements.

## 2.4 GRID K1 /K2 SPECIFICATIONS

Table 2-2 lists the GRID K1 and K2 hardware specifications.

Table 2-2. GRID K1 and GRID K2 Hardware Specifications

	GRID K1	GRID K2
Number of GPUs	4 x K600 equivalent Kepler GPUs	2 x K5000 equivalent Kepler GPUs
Total NVIDIA CUDA Cores	768	3072
Total Memory Size	4GB DDR3 per GPU (16GB total)	4 GB GDDR5 per GPU (8GB total)
Max Power	130 W	225 W
Board Length	10.5	10.5
Board Height	4.4	4.4
Board Width	Dual slot	Dual slot
Display IO	None	None
Aux Power	6-pin connector	8-pin connector
PCIe	x16	x16
PCIe Generation	Gen3 (Gen2 compatible)	Gen3 (Gen2 compatible)
Cooling Solution	Passive	Passive
Complete Technical Specifications	See <a href="http://www.nvidia.com/content/grid/pdf/GRID_K1_BD-06633-001_v02.pdf">http://www.nvidia.com/content/grid/pdf/GRID_K1_BD-06633-001_v02.pdf</a>	See <a href="http://www.nvidia.com/content/grid/pdf/GRID_K2_BD-06580-001_v02.pdf">http://www.nvidia.com/content/grid/pdf/GRID_K2_BD-06580-001_v02.pdf</a>
<b>Note:</b> Refer to <a href="http://www.nvidia.com/object/grid-technology.html">http://www.nvidia.com/object/grid-technology.html</a> for more specifications.		

## 2.5 SUPPORTED GRAPHICS PROTOCOLS

This version of GRID vGPU includes support for:

- Full DirectX 9/10/11, Direct2D, and DirectX Video Acceleration (DXVA)

- ▶ OpenGL 4.4
- ▶ NVIDIA GRID SDK (remote graphics acceleration)

The following are NOT supported in this release of vGPU:

- ▶ CUDA
- ▶ OpenCL

NOTE: For CUDA and OpenCL we recommend using vDGA (not covered in this guide).

## 2.6 HOMOGENOUS VIRTUAL GPUS

GRID vGPU supports homogeneous virtual GPUs. At any given time, the virtual GPUs residing on a single physical GPU must be all of the same type. However, this restriction does not extend across physical GPUs on the same card. Each physical GPU on a K1 or K2 may host different types of virtual GPUs at the same time. For example, a GRID K2 card has two physical GPUs and can support four types of virtual GPU: GRID K220Q, GRID K240Q, GRID K260Q, and GRID K280Q.

Graphic showing possible vGPU profile distribution:

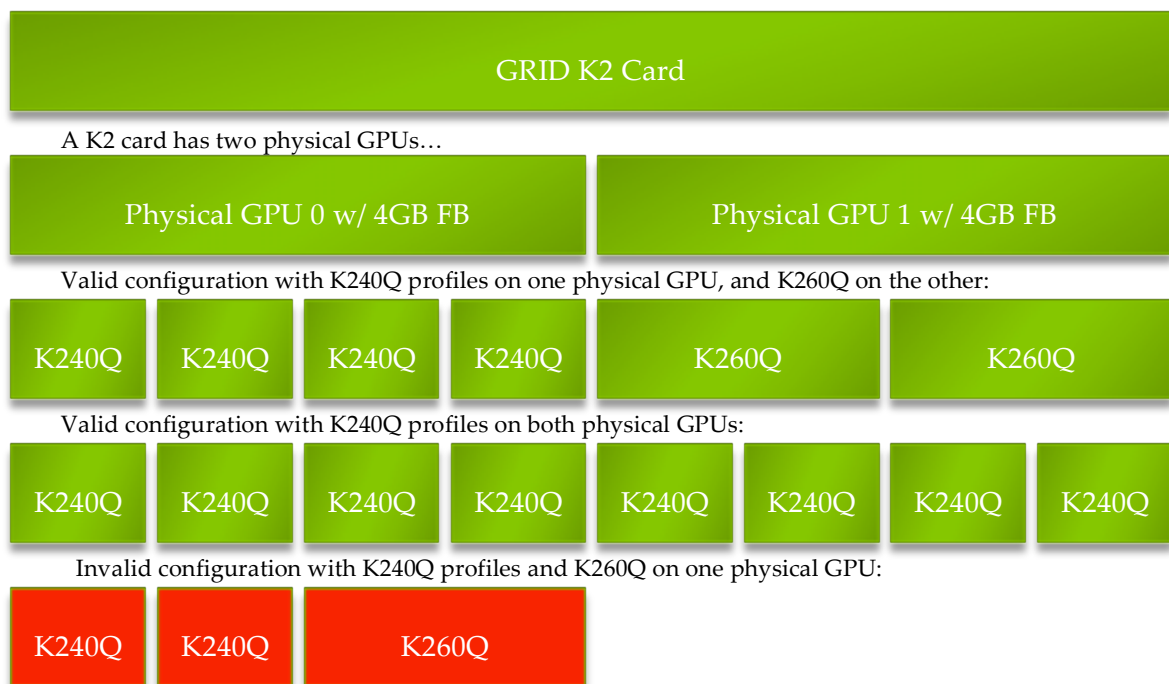


Figure 2-3. Example of a vGPU Configurations on GRID K2

## 2.7 DISTRIBUTION OF VIRTUAL GPUS

When a GRID vGPU guest is started up, Horizon looks to the first available host in the cluster and queries vSphere if it can place the guest there based on available GPUs. If not, for example the host is offline, then Horizon moves on to the next available host. As a part of that query Horizon and vSphere will determine if the host's GPU is a K2 or K1 and if the guest's assigned vGPU profile can be placed on that host (e.g. a guest with K120Q could not be placed on a host with K2 cards). The advantage is a cluster made up of hosts with both K1 and K2 cards can have pools with profiles for either and Horizon 6.1 and vSphere 6 will manage distributing those guests appropriately.

On each individual host the GRID vGPU guests are distributed across all available physical GPUs, ensuring the guests get the maximum available performance, versus loading up the first physical GPU before moving on to the next to ensure maximum density. This is referred to as breadth-first over depth-first.

Graphic showing possible vGPU profile distribution:

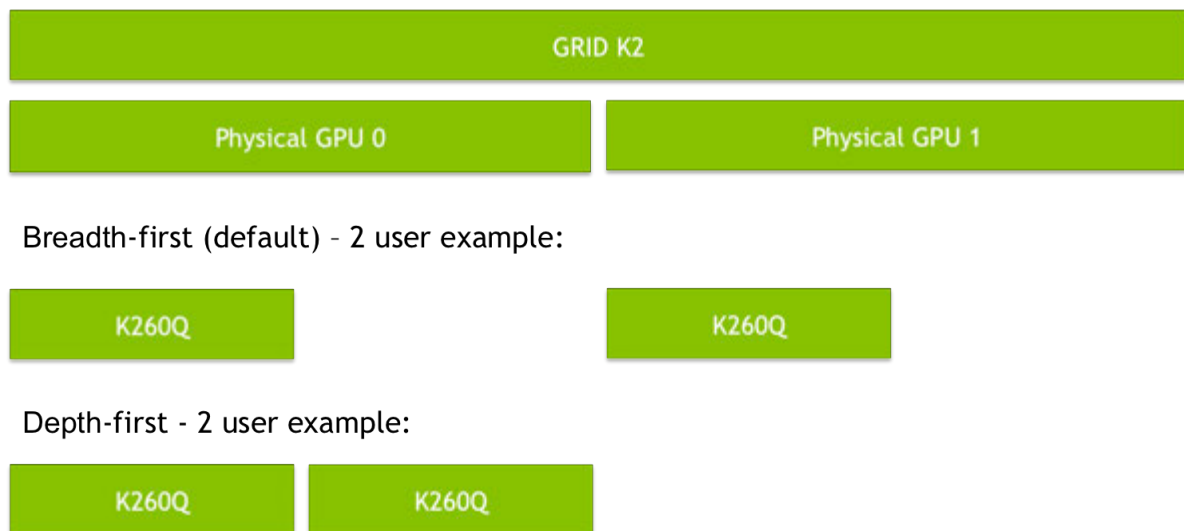


Figure 2-4. Example of vGPU Distribution on GRID K2

Architecturally the only challenge is with guests of different profiles but for the same card type, for example a K220Q and a K260Q are both K2 profiles. In this case it would be possible for the pool of K220Q guests to be spread across all available GPUs on a host, leaving no free GPUs for the K260Q pool. If there is another K2 host available then the second pool can start placing guests there. Careful calculation of available hosts and GPUs, or assigning hosts to profile specific clusters, is necessary to ensure all guests have the necessary resources to power up.



## 2.8 BEFORE YOU BEGIN

This section describes the general prerequisites and some general preparatory steps that must be addressed before proceeding with the deployment.

### 2.8.1 Direct Access

DIRECT ACCESS TO NVIDIA GRID™ vGPU™ WITH VMware Horizon® and vSphere® APPLICATION INFORMATION AND PROGRAM BENEFITS NVIDIA and VMware recently announced a Direct Access program that provides qualified enterprise customers the benefit of customized, hands-on support and consulting with NVIDIA and VMware's End User Computing (EUC) resources. This partnership will assist and accelerate the deployment of Horizon desktop virtualization leveraging NVIDIA GRID vGPU with VMware Horizon and vSphere. This is an exclusive, limited access program for select worldwide customers who meet direct access program requirements. In order to qualify you must be a current VMware customer, running vSGA or vDGA on NVIDIA GRID K1 or K2 hardware today.

DIRECT ACCESS PROGRAM BENEFITS Approved candidates that are enrolled in the program will receive:

- Direct access to NVIDIA and VMware resources to help optimize your deployment Receive early access to evaluate new technologies and products
- Invitation to participate in a Private Direct Access program forum monitored by NVIDIA and VMware technical experts
- Provide direct input on the product to NVIDIA and VMware product managers, engineers and technical teams to influence future products, training, documentation, and services
- Collaborate with other program participants and share feedback via a private Direct Access community
- Invitation to bi-monthly webinars only open to program participants
- Priority Access to EUC consulting services from both VMware and NVIDIA (costs associated)
- Channel Partner participation in Direct Access program with their customer

See more at: <http://www.nvidia.com/object/vmware-vgpu-direct-access>

### 2.8.2 Build An Evaluation Plan

To be successful, we highly recommend you start with evaluation plan consisting of all of the following:

- Listed business drivers and goals
- List of all user groups, their workloads and applications



- Current end-user experience measurements and analysis
- ROI/density goals

### 2.8.3 Size Your Environment

Based on your evaluation plan, we recommend sizing an appropriate environment for each user group you are trying to reach with your evaluation.

For example, here are three example Revit user use cases and their computing needs:

- ▶ Entry Level Engineer / Design Reviewer
  - 4 GB RAM
  - 2 VCPUs (2.5 GHz)
  - 1 GB video RAM
  - 2 2560x1600 displays
- ▶ Mid Level Engineer
  - 8 GB RAM
  - 2-4 VCPUs (2.5 GHz)
  - 2 GB video RAM
  - 4 2560x1600 displays
- ▶ Advanced Engineer
  - 16 GB RAM
  - 4-8 VCPUs (2.5 GHz)
  - 4 GB video RAM
  - 4 2560x1600 displays

Based upon your needs, make sure to include enough RAM, CPUs, and GPUs to meet your sizing needs.

### 2.8.4 Choosing Your Hardware

The following elements are required in order to install and configure vGPU on VMware vSphere 6:

- ▶ VMware and NVIDIA certified servers with NVIDIA GRID K1 or K2 cards (see <http://www.nvidia.com/buygrid> for a list of certified NVIDIA servers and cross check that against the VMware HCL) that meet the following recommended specifications:
  - 2.5GHz CPU or faster (Ivy Bridge, Haswell)
  - High-speed RAM
  - Fast networking

- If using local storage IOPS plays a major role in performance. If using VMware for Virtual SAN, see the VMware Virtual SAN requirements website for more details.
- ▶ High performance storage with Virtual SAN or high IOPS storage system
- ▶ Higher-performance end points for testing access

## 2.8.5 General Prerequisites

The following elements are required in order to install and configure vGPU on VMware vSphere 6:

- ▶ Evaluation plan consisting of all of the following:
  - Listed business drivers and goals
  - List of all user groups, their workloads and applications
  - Current end-user experience measurements and analysis
  - ROI/density goals
  - Review VMware's Horizon with View Getting Started page:
- ▶ <http://www.vmware.com/products/horizon-view/gettingstarted> Certified servers with NVIDIA GRID K1 or K2 cards (see <http://www.nvidia.com/buygrid> for a list of certified servers) that meet the following recommended specifications:
  - 2.5GHz CPU or faster (Ivy Bridge, Haswell)
  - High-speed RAM
  - Fast IOPS storage
  - Fast networking
- ▶ Higher-performance end points for testing access

Select the appropriate NVIDIA GRID card for your use case, either K2 for higher performance solutions or K1 for density (refer to <http://www.nvidia.com/object/grid-boards.html> for details). For additional guidance, please contact your NVIDIA and VMware reps.

- ▶ VMware vSphere 6
  - You may deploy vCenter Server 6 on a Windows server or as an OVA Appliance.
- ▶ VMware Horizon 6.1
- ▶ If needed, you may register for a trial to obtain the license keys required for various elements to deploy and manage Horizon at:
   
<https://my.VMware.com/group/VMware/evalcenter?p=horizon>.
- ▶ NVIDIA vGPU software:
  - NVIDIA vGPU manager VIB
  - NVIDIA WDDM guest driver (32-bit and 64-bit versions)



The vGPU Manager VIB is loaded similar to a driver in the vSphere hypervisor, and is then managed by the vCenter Server.

- ▶ Microsoft software:
  - Windows Server 2012 R2 (recommended) or Server 2008 R2 (minimum)
  - Windows 7 SP1 Professional or Enterprise VL (for use as the guest operating system)
- ▶ Your choice of a CLI/SSH/SCP tools installed on your Windows-based toolbox PC, for example:
  - Putty (SSH) and WinSPC (SPC), available from [www.putty.org](http://www.putty.org) and [www.winscp.net](http://www.winscp.net), respectively. See Chapter 15, *Using WINSCP*, on page 225 for information on using WinSCP.
- ▶ Licenses:
  - VMware vSphere 6
  - VMware Horizon 6.1
  - Microsoft (volume licenses recommended)
- ▶ Testing and Benchmarking:
  - NVIDIA System Management interface (NSMI)
  - OPTIONAL: VMware vRealize Operations for Horizon (V4H)
  - OPTIONAL: Lakeside Systrack 7 with GPU monitoring
- ▶ Server where you will install Horizon Connection Server 6:
  - Windows Server 2012 R2
  - Server must be joined to a domain
  - Server must have a static IP address assigned

## 2.8.6 Pre-Installation Preparation

Perform the following procedure prior to installation:

1. Determine how vSphere will run on the physical hosts. Consider booting from a thumb drive or SAN.
2. Download and install a SSH and SCP tool, examples are:
  - PuTTY (SSH)
  - WinSCP (SCP)
3. Set the BIOS on the physical hosts as appropriate. See 2.8.8, *Server BIOS Settings* on page 17.

4. Install Virtual Clone Drive or similar to easily mount and un-mount ISO images within the virtual machines.

## 2.8.7 Known Limitations

See Chapter 13, *Known Issues*, on page 207 for a list of known limitations that is current as of the publication date of this manual.

## 2.8.8 Server BIOS Settings

Configure the BIOS as appropriate for your physical hosts, as described below:

### 2.8.8.1 Cisco

- ▶ CPU Performance: Set this parameter to either **Enterprise** or **High Throughput**.
- ▶ Energy Performance: Set this parameter to **Performance**.
- ▶ PCI Configuration: Set the following parameters:
  - MMCFG BASE: Change this value from **Auto** to **2 GB**.



**CAUTION: FAILURE TO CHANGE THIS VALUE MAY CAUSE THE VSPHERE INSTALLATION TO FAIL WHILE BOOTING THE ISO.**

- Memory Mapped I/O above 4-GB: Set this parameter to **Disabled**.
- ▶ VGA Priority: Set this parameter to **Onboard VGA Primary**.
- ▶ Refer to the *Cisco Unified Computing System BIOS Settings* page at the Cisco website for additional Cisco-specific BIOS settings.

### 2.8.8.2 Dell

- ▶ System Profile: Set this parameter to **Performance**.
- ▶ Memory Mapped I/O Above 4 GB: Set this parameter to **Disabled**



If NVIDIA card detection does not include all of the installed GPUs, set this option to **Enabled**

- ▶ Embedded Video Controller: Set this parameter to **Enabled**.
- ▶ Refer to the Dell BIOS Settings page at the Dell website for additional Dell-specific BIOS settings.

### 2.8.8.3 HP

- ▶ HP Power Profile: Set this parameter to **Advanced**.

- ▶ HP Power Regulator: Set this parameter to HP Static High Performance Mode.
- ▶ Energy/Performance Bias: Set this parameter to Maximum Performance.
- ▶ Memory Power Savings Mode: Set this parameter to Maximum Performance.
- ▶ Video Options: Set this parameter to Embedded Video Primary, Optional Video Secondary.

#### 2.8.8.4 Supermicro

- ▶ Power Technology: Set this parameter to either Maximum Performance or Energy Efficient.
- ▶ Energy/Performance Bias: Set this parameter to either Performance or Balanced Performance.
- ▶ Above 4G Decoding: Set this parameter to Disabled.
- ▶ MMCFG base: Set this parameter to 0xC0000000.

#### 2.8.8.5 Others

Memory Mapped I/O above 4-GB: When available, set this parameter to **Disabled**, unless vSphere installation fails or returns an error; in this case, enable the 4-GB memory mapping until the base vSphere installation is complete, and then disable this setting again before proceeding to vGPU VIB install.

# Chapter 3.

## INSTALLING VSPHERE 6

This chapter covers the following vSphere 6 installation topics:

- ▶ Choosing an install method
- ▶ Preparing the USB boot media
- ▶ Installing vSphere 6 from the USB media
- ▶ Initial host configuration
- ▶ Assigning a host license

NOTE: This deployment guide assumes you are building an environment as a proof of concept and is not meant to be a production deployment, as a result choices made are meant to speed up and ease the process. See the corresponding guides for each technology, and make choices appropriate for your needs, before building your production environment.

### 3.1 CHOOSING INSTALL METHOD

With the ability to install from and onto a SD card or USB memory stick, vSphere offers flexibility verses local hard drive install. Please see vSphere documentation regarding best practices for logs when booting from USB or similar. In our main lab we used Supermicro's IPMI and virtual media to boot from ISO file and install on local storage. In home labs USB was used to quickly move from one version to another.

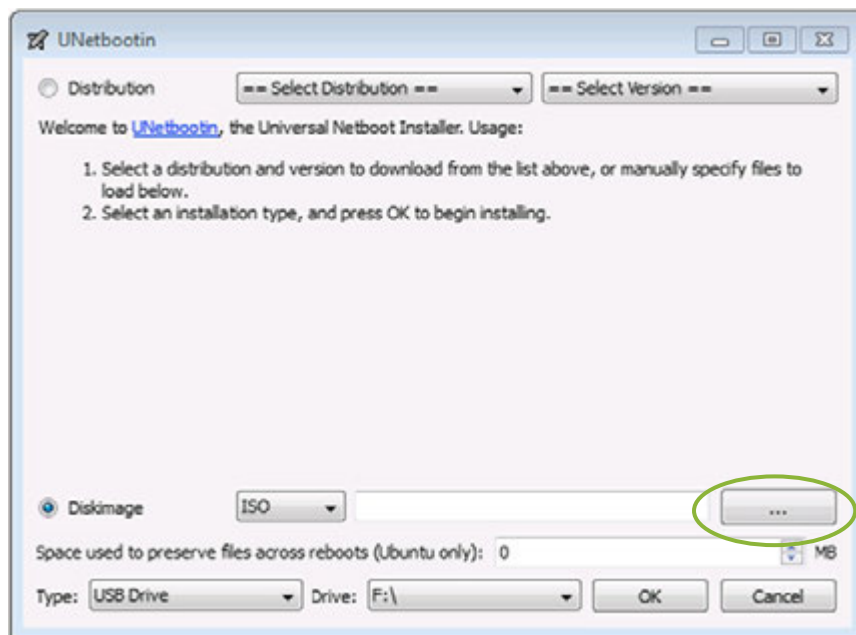
## 3.2 PREPARING USB BOOT MEDIA

Reference VMware KB: “Installing ESXi 5.x on a supported USB flash drive or SD flash card (2004784)”

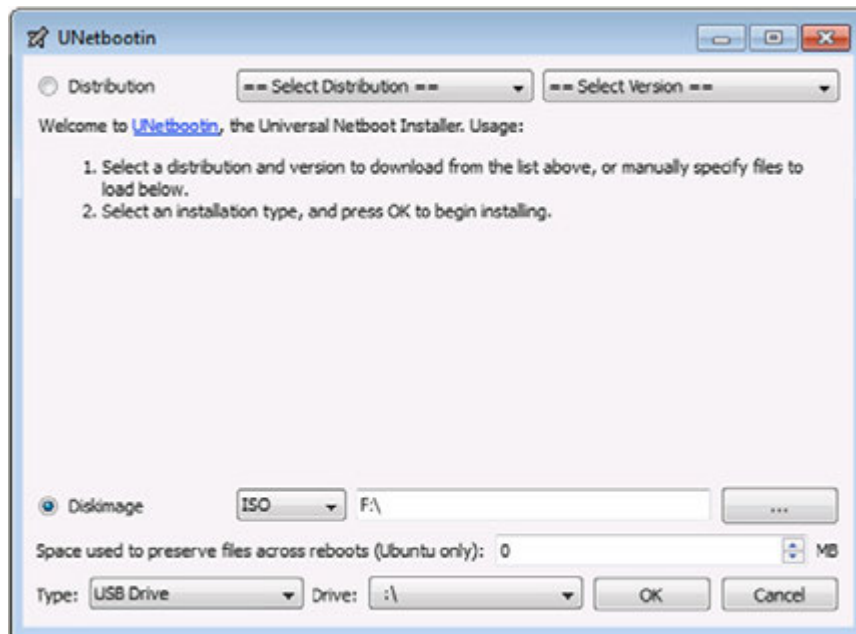
Booting vSphere 6 from a USB drive is useful if your host has an existing vSphere Version 5.5 or earlier installation that you want to retain.

Use the following procedure to prepare a USB drive for booting:

1. Download **UNetbootin** from <http://unetbootin.sourceforge.net/>.  
The Windows version of the application does not include an installer; however, the OSX version is packaged in a **.DMG** file that you must mount. You must also copy the application to the **Applications** folder before launching. Alternatively, you can use YUMI, which allows booting multiple installation images on one USB device plus the option to load the entire installation into RAM. The download link is <http://www.pendrivelinux.com/yumi-multiboot-usb-creator/>.
2. Start the application, select **Diskimage**, and then click the ... icon to browse for the installation **.ISO** file.



3. Navigate to the location that contains the installation **.ISO** file and then select **Open**.
4. Select the mounted USB drive on which to perform the installation and then select **OK**.  
The copying process begins and a series of progress bars are displayed.



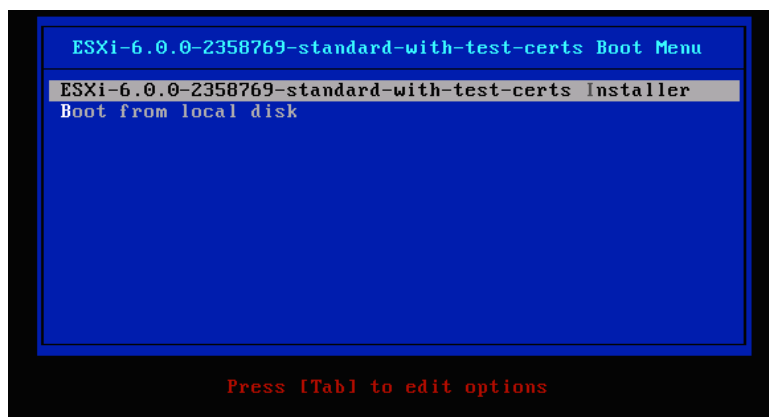
5. When the copying process is complete, click Exit and then remove the USB drive.
6. To install from this USB drive, insert into the host using either an internal or on motherboard USB port, then set that as the primary boot source or select from the boot menu on power up.

### 3.3 INSTALLING VSPHERE 6

Use the following procedure to install the vSphere 6 regardless of boot source. Select the boot media with the vSphere ISO on your host's boot menu.

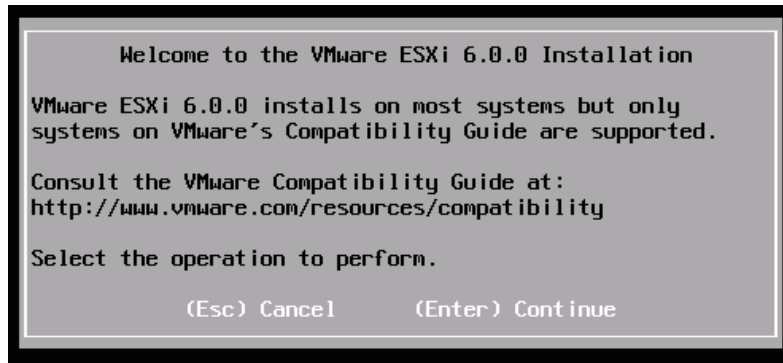
1. Apply power to start the host.

The following menu displays when the host starts up:

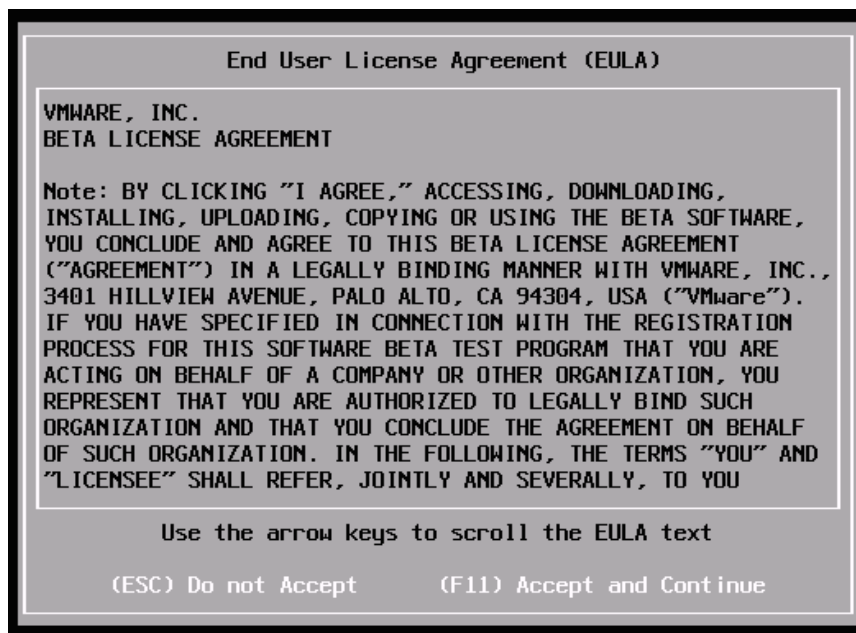




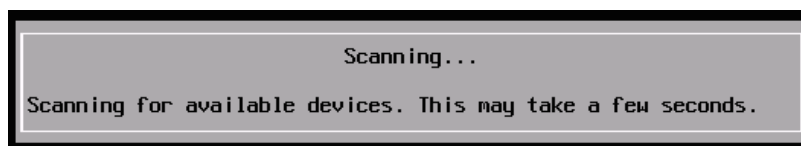
2. Select the installer using the arrow keys and then press **[ENTER]** to begin booting the vSphere 6 installer.
3. A compatibility warning displays:



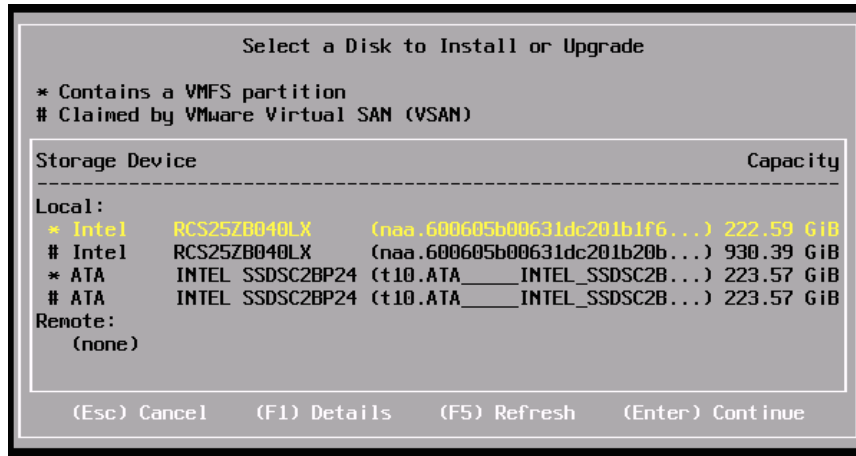
4. Press **[ENTER]** to proceed.  
 The End User License Agreement (EULA) displays:



5. Read the EULA and then press **[F11]** to accept it and continue the installation.  
 The installer scans the host to locate a suitable installation drive:



6. It should display all drives available for install:

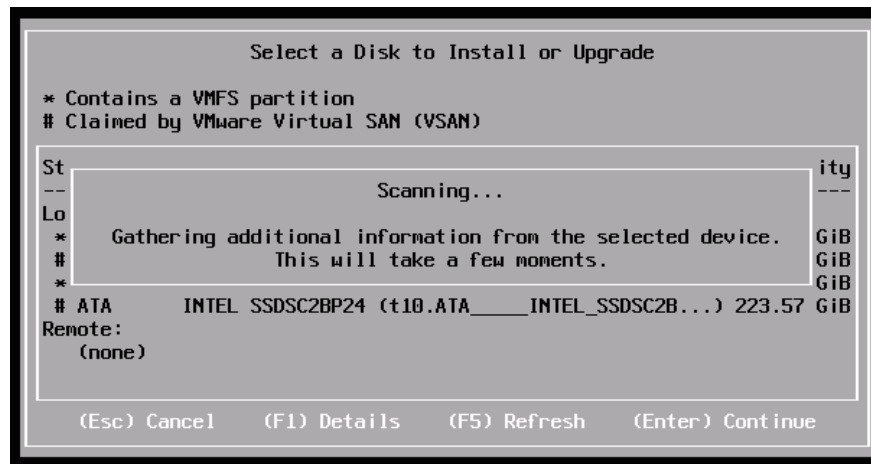


- Use the arrow keys to select the drive you want to install vSphere 6 and then press **[ENTER]** to continue.

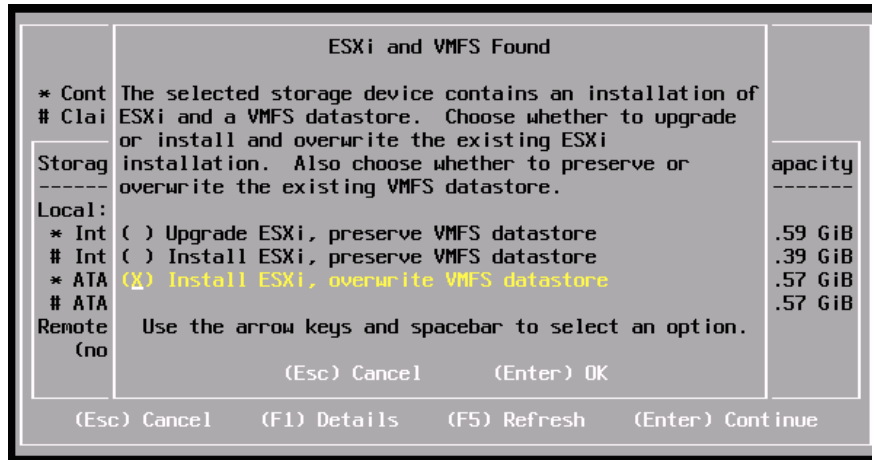


You can install vSphere 6 to a USB drive and then boot and run the system from that USB drive. This sample installation shows vSphere being installed on a local hard drive.

- The installer scans the chosen drive to determine suitability for install:



- The Confirm Disk Selection window displays:



10. Press **[ENTER]** to accept your selection and continue  
The **Please select a keyboard layout** window displays:



11. Select your desired keyboard layout using the arrow keys and then press **[ENTER]**.  
The **Enter a root password** window displays.

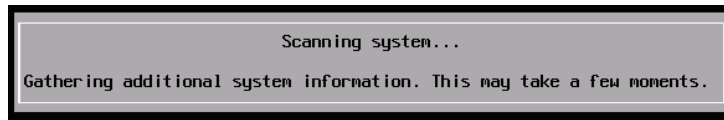


12. Enter a root password in the Root password field.

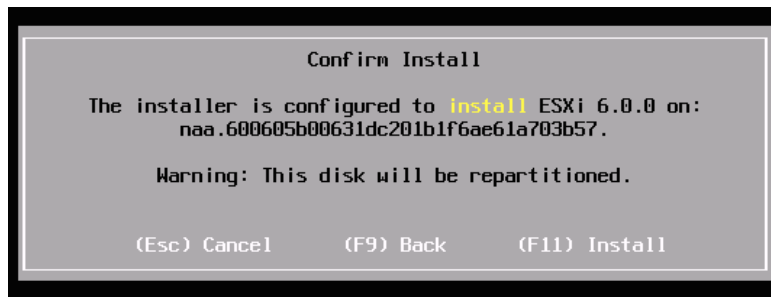


**CAUTION:** TO PREVENT UNAUTHORIZED ACCESS, YOUR SELECTED ROOT PASSWORD SHOULD CONTAIN AT LEAST EIGHT (8) CHARACTERS AND CONSIST OF A MIX OF LOWERCASE AND CAPITAL LETTERS, DIGITS, AND SPECIAL CHARACTERS.

13. Confirm the password in the **Confirm password** field and then press **[ENTER]** to proceed. The installer rescans the system:



14. Then displays the **Confirm Install** window:

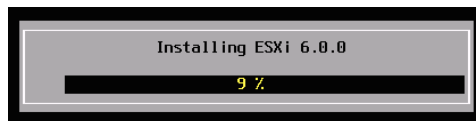


15. Press **[F11]** to proceed with the installation.

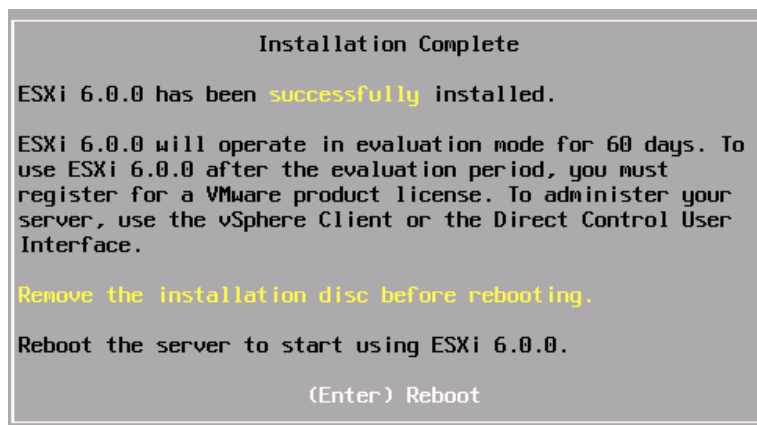


**CAUTION: THE INSTALLER WILL REPARTITION THE SELECTED DISK. ALL DATA ON THE SELECTED DISK WILL BE DESTROYED**

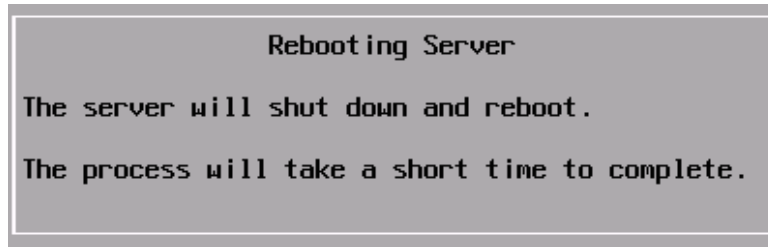
16. The vSphere 6 installation proceeds:



17. The **Installation Complete** window displays when the installation process is completed:



18. Press **[ENTER]** to reboot the system. (Make sure your installation media has been ejected and you bios set to the boot disk.)



The installation is now complete.

## 3.4 INITIAL HOST CONFIGURATION

A countdown timer displays when you first boot vSphere 6. You can wait for the countdown to expire or press **[ENTER]** to proceed with booting. A series of notifications displays during boot.

The VMware vSphere 6 screen displays once the boot completes:

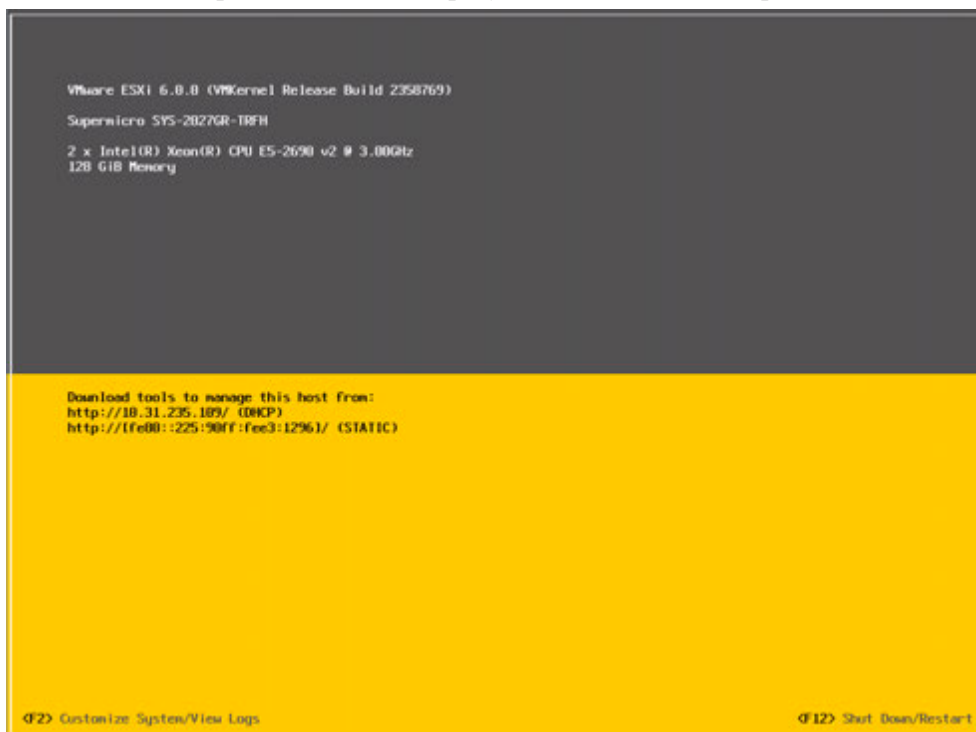
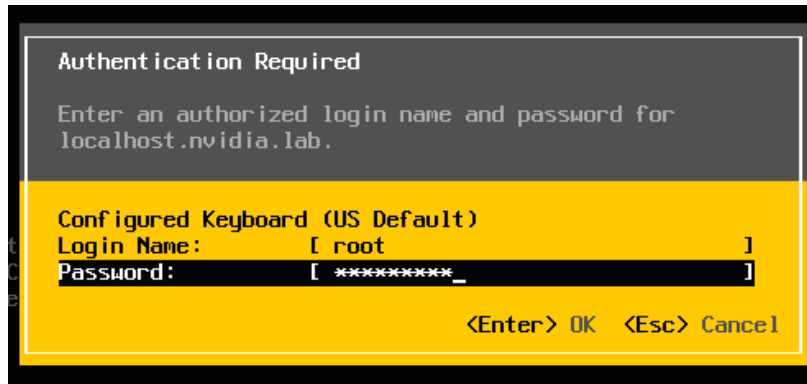


Figure 3-1. VMware vSphere 6 Screen

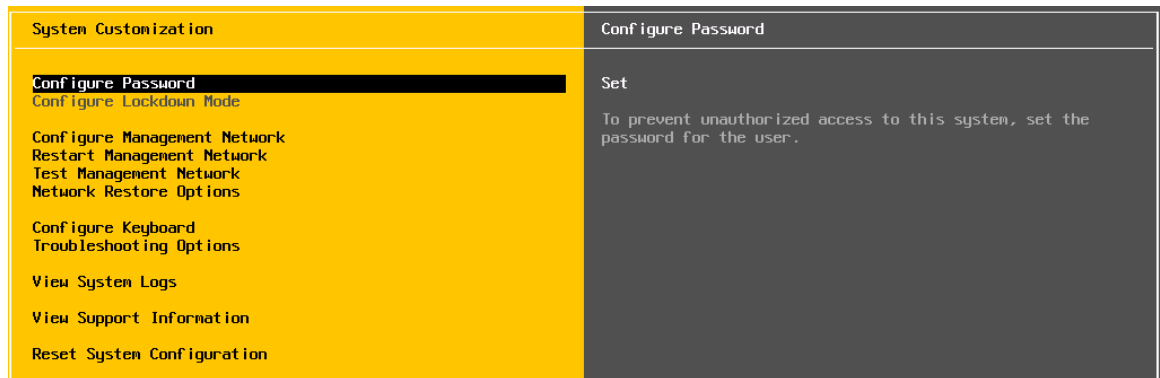
Use the following procedure to configure the host:

1. Press [F2].

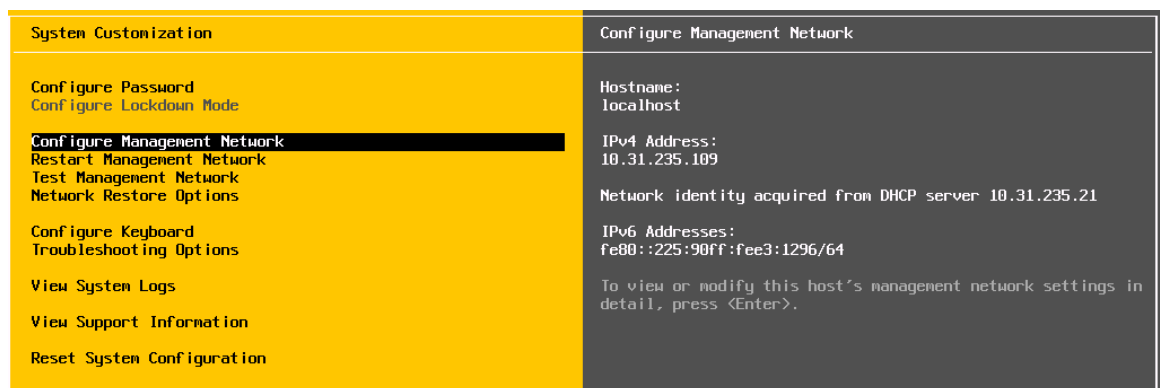
The **Authentication Required** window displays:



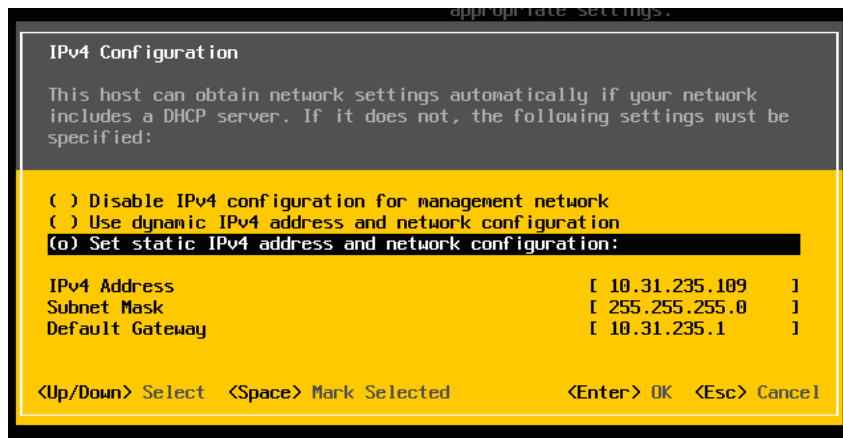
2. Enter the root account credentials that you created during the installation process and then press [ENTER]. The **System Customization** screen displays.



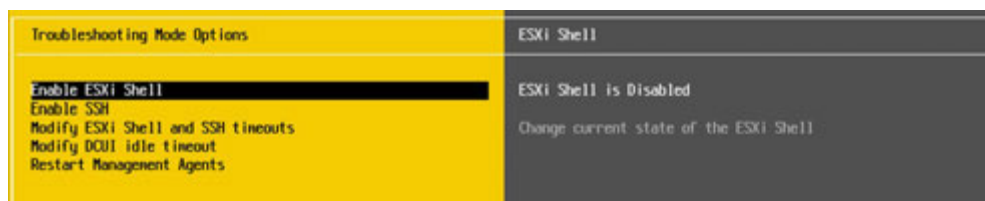
3. Scroll down to select **Configure Management Network** and then press [ENTER]. The **Network Adapters** window appears:



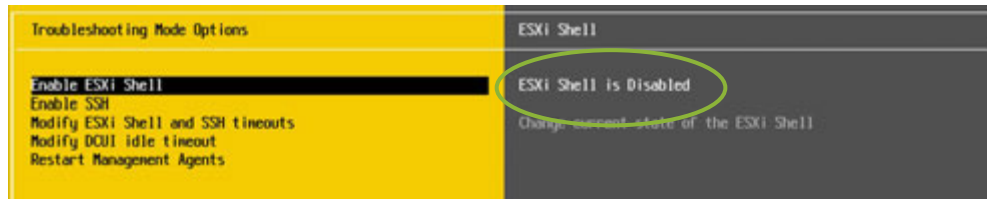
4. Use the arrow keys to select the adapter to use as the default management network and then press [ENTER]. The **IPv4 Configuration** window displays:



5. Use the arrow keys to select **Set static IPv4 address and network configuration** and then enter the IPv4 address, subnet mask, and default gateway in the respective fields.
6. Press **[ENTER]** when finished to apply the new management network settings. The **Confirm Management Network** popup displays.
7. Press **[Y]** to confirm your selection. The **DNS Configuration** window displays.
8. Add the primary and (if available) secondary DNS server address(es) in the respective fields.
9. Set the host name for this vSphere host in the **Hostname** field.
10. Press **[ENTER]** when finished.
11. Select **Test Management Network** on the main vSphere 6 screen to open the **Test Management Network** window.
12. Perform the following tests:
  - Ping the default gateway.
  - Ping the DNS server.
  - Resolve a known address.
13. Return to the main vSphere 6 screen when you have completed testing, and then select **Troubleshooting Options**. The **Troubleshooting Mode Options** window displays.



14. In order to install the NVIDIA VIB in a later step, you will need to enable the vSphere Shell. This can be accomplished by selecting **Enable vSphere Shell**.
15. Press **[ENTER]** to toggle **Enable vSphere Shell** on.  
The window on the right displays the status: **Enable vSphere Shell Disabled**



16. Enable SSH by selecting **Enable SSH** and press **[ENTER]** to toggle this option on.  
The window on the right displays the status: **SSH is Enabled**



# Chapter 4.

## INSTALLING VMWARE VCENTER 6 SERVER

This chapter covers installing VMware vCenter 6 Server, including:

- ▶ An installation walk through
- ▶ The initial vCenter Server Configuration
- ▶ Adding a host
- ▶ Setting a vCenter appliance to auto-start
- ▶ Mounting an NFO ISO data store

Review the prerequisites in section 2.8.5, *General Prerequisites* on page 13 before proceeding with these installations.

NOTE: This deployment guide assumes you are building an environment for a proof of concept. Refer to VMware best practice guides before building your production environment.

### 4.1 INSTALLING VCENTER 6 SERVER APPLIANCE

#### 4.1.1 Initial Installation

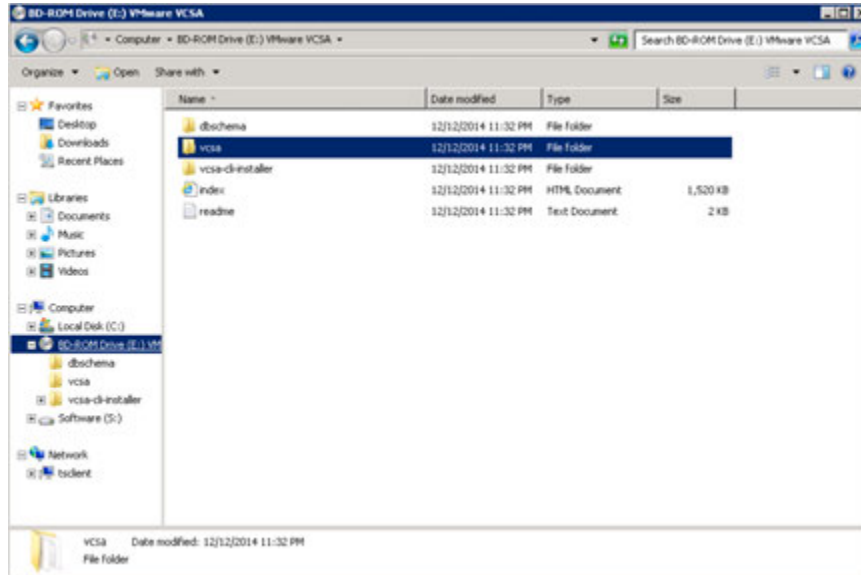
Use the following procedure to install vCenter 6 Server Linux Appliance, starting with an Internet Explorer plug-in that allows vCenter Server install from your current desktop.

#### 4.1.1.1 vCenter Server Client Integration Plug-in Installation

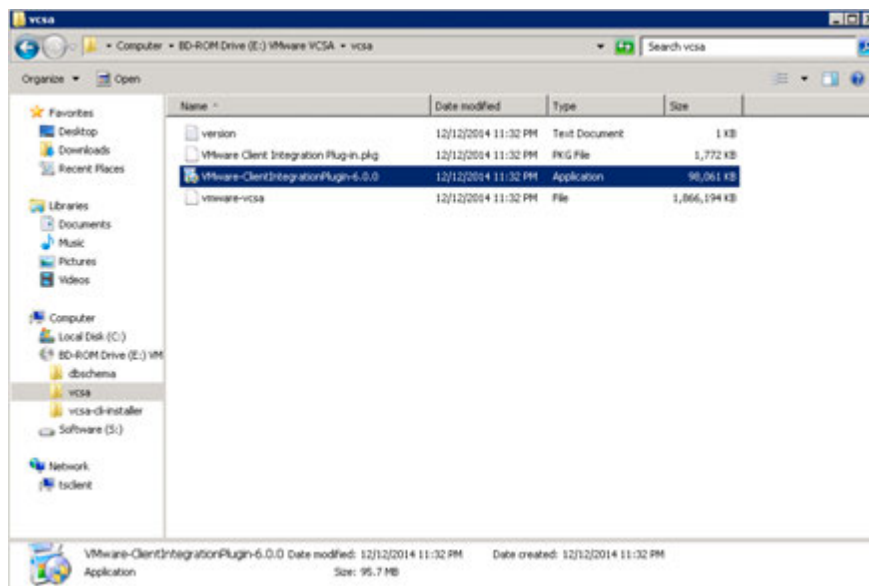
The vCenter Server Client Integration Plug-in needs to be installed to enable the vCenter Server Appliance install (as well as uploading files from your desktop to data stores).

Use the following procedure to install the plug-in:

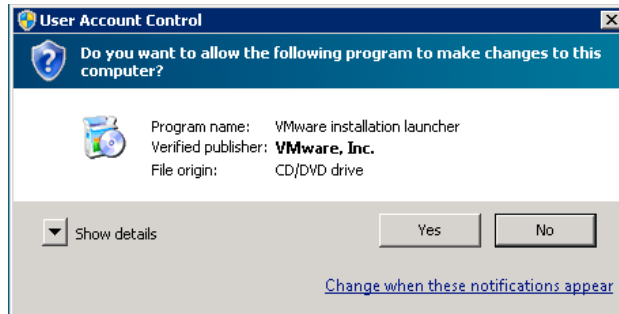
1. Mount the VMware ISO with the installation media in the drive
2. Browse to the VCSA folder:



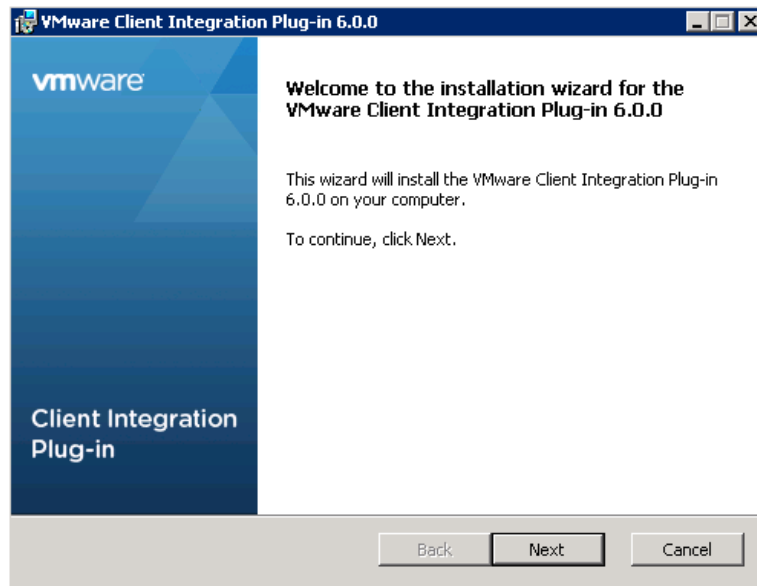
3. In the VCSA folder, double click the VMware-ClientIntegrationPlugin-6.0.0 installer:



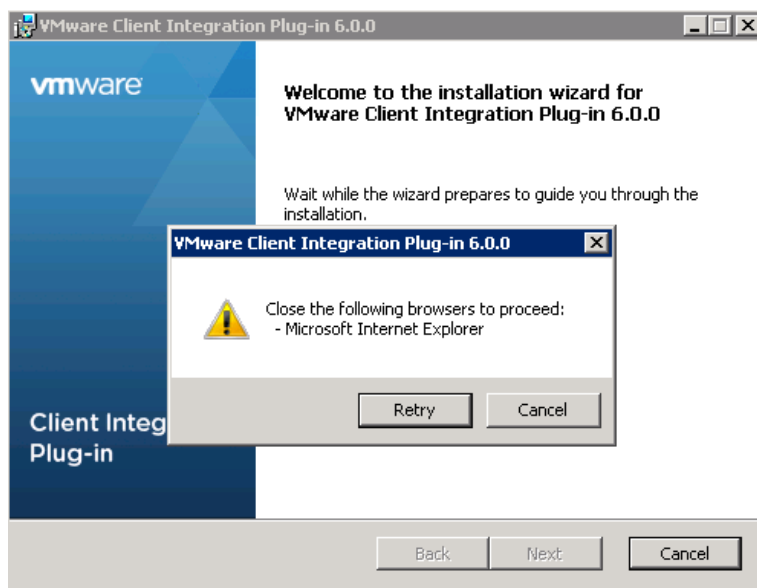
4. If the Microsoft UAC prompts, click [YES] to allow the install to begin:



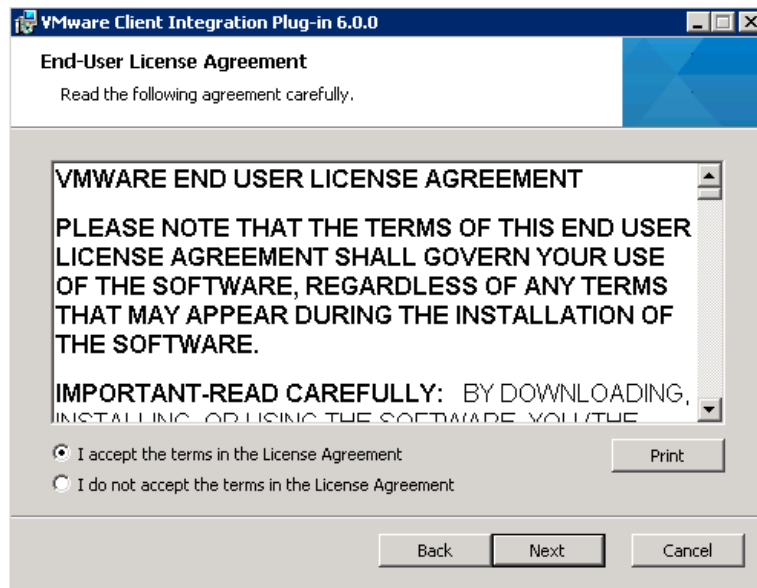
5. Installer starts, click **[Next]** to continue:



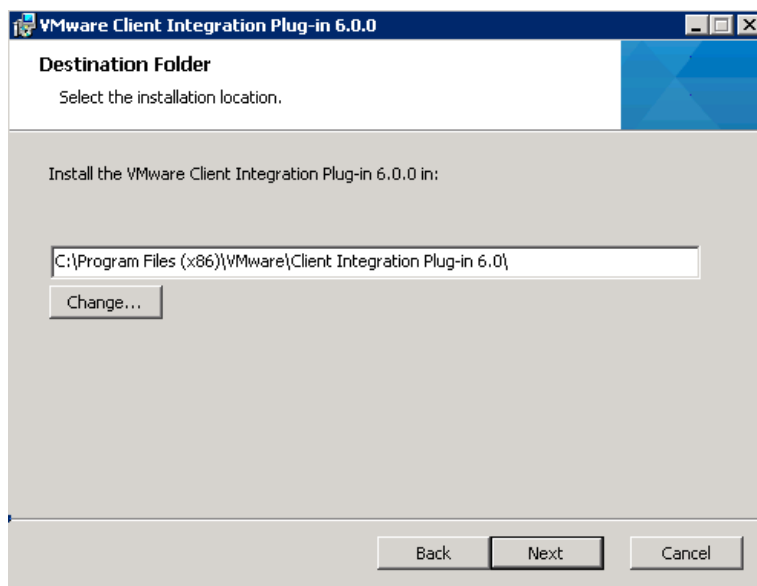
NOTE: All browsers must be closed or you will be prompted to close them, if this window pops up then close all listed browsers and click **[Retry]** to continue:



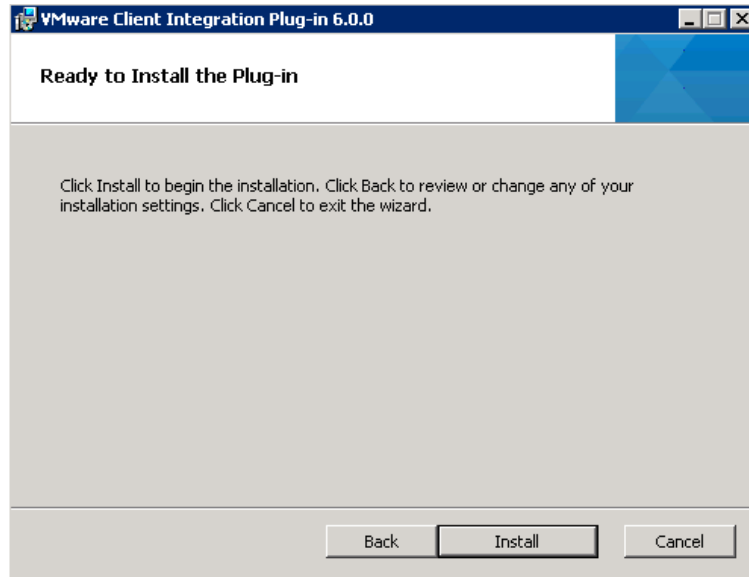
6. Accept the EULA and click **[Next]** to continue:



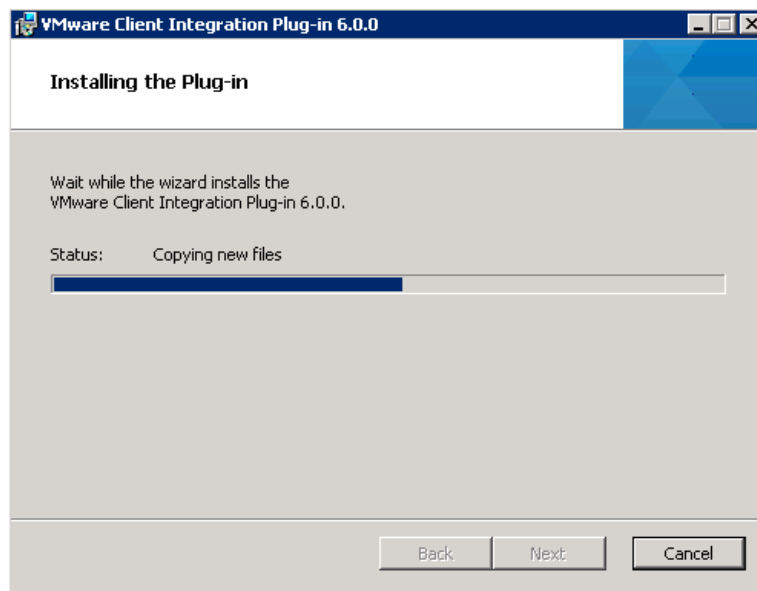
7. Select the install destination folder and click **[Next]**:



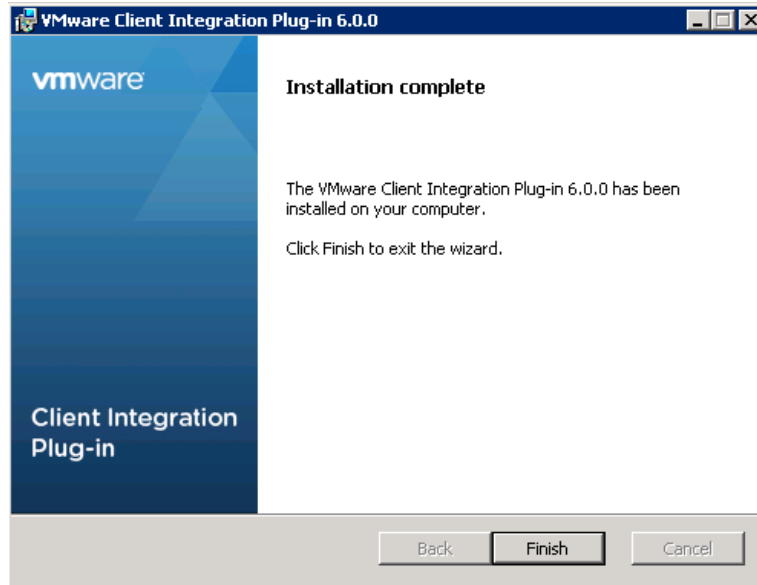
8. Click **[Install]** to begin the installation:



9. Install in progress...



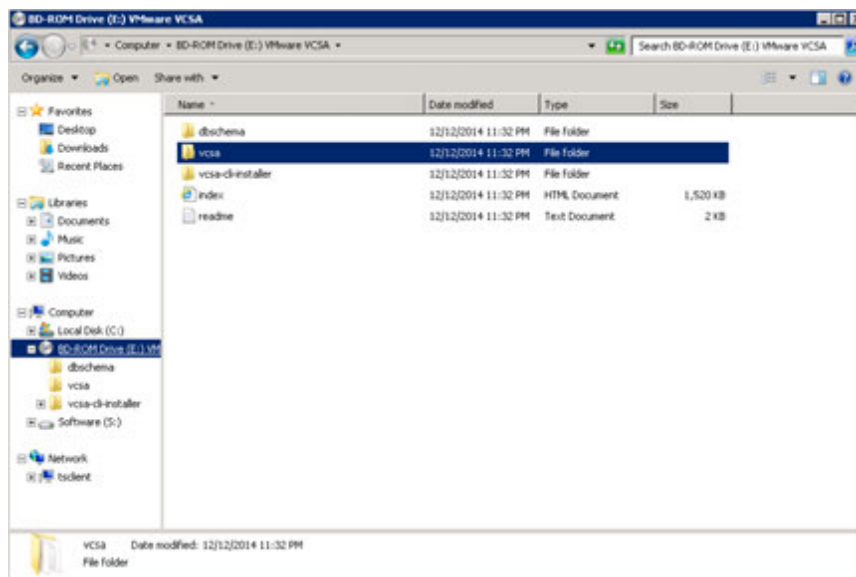
10. When install completes, click **[Finish]**:



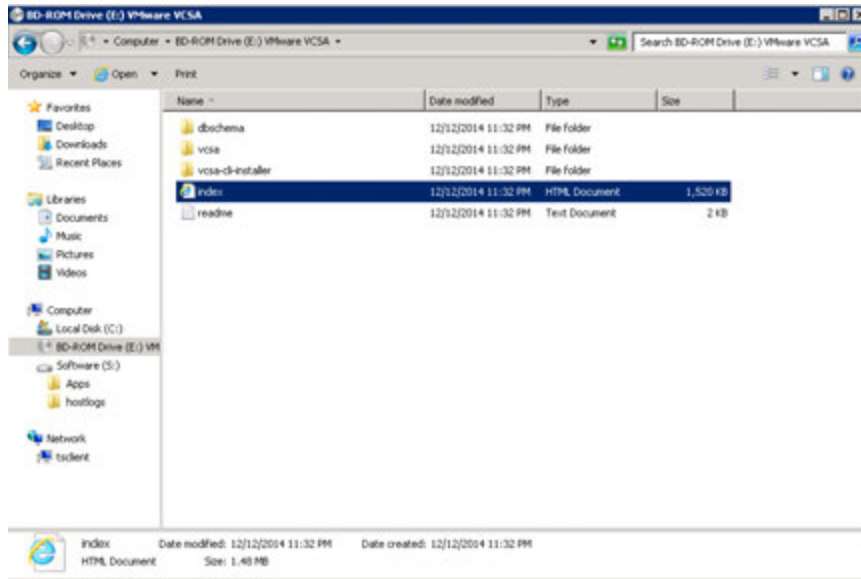
#### 4.1.1.2 vCenter Server Appliance (VCSA) installation

Using a web installer and the client integration plug-in from above, you now install the VCSA.

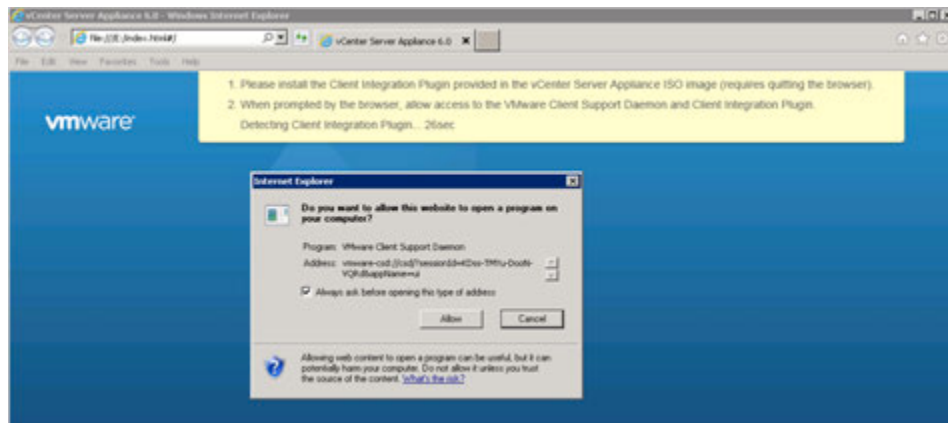
11. Mount the VMware VCSA ISO with the installation media in the drive.
12. Browse to the VCSA folder:



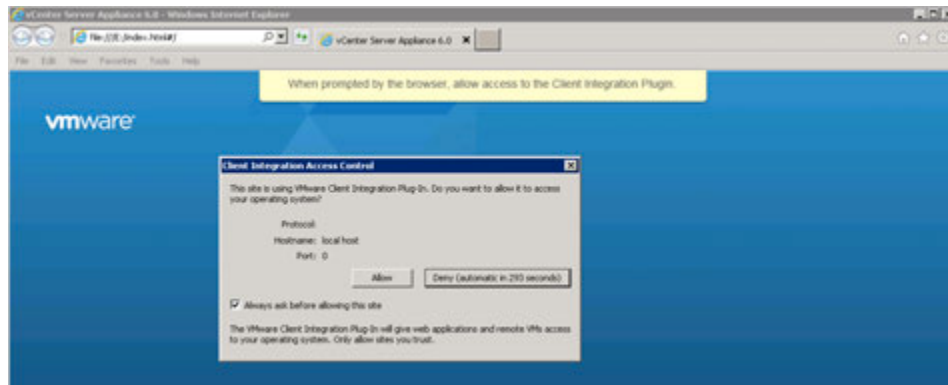
13. Open the html file "index" in Internet Explorer:



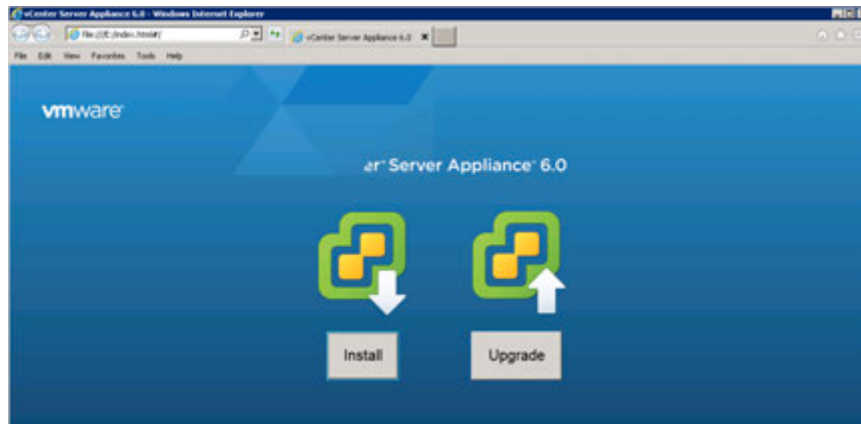
14. Below is the alert you will receive if the VMware Client Integration Plug-in is not installed.



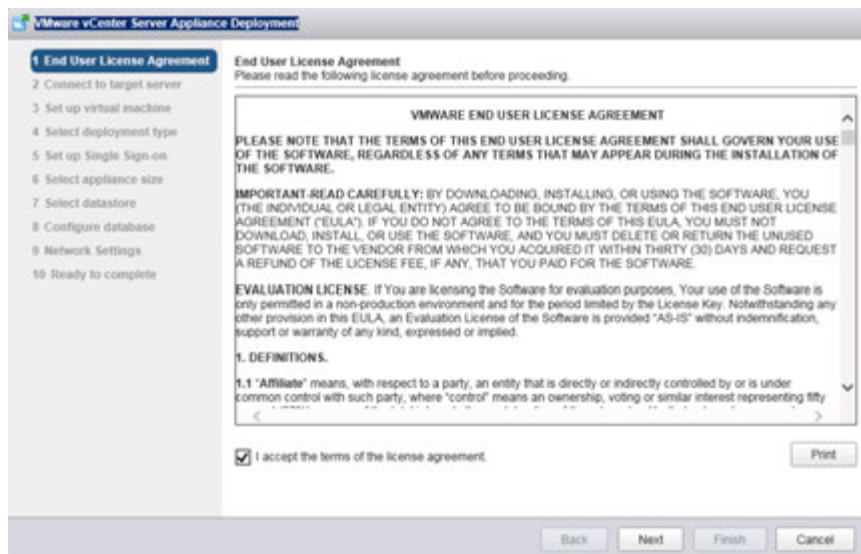
15. If the plug-in is active, you are prompted to allow it access to your operating system, click **[Allow]**:



16. To begin the install of the VCSA on a host click **[Install]**:

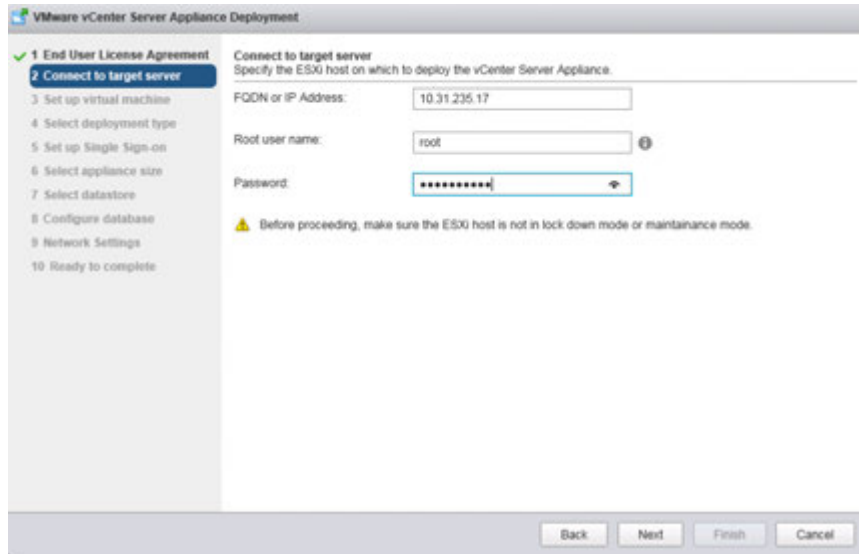


17. Read and then accept the EULA, click **[Next]** to continue:

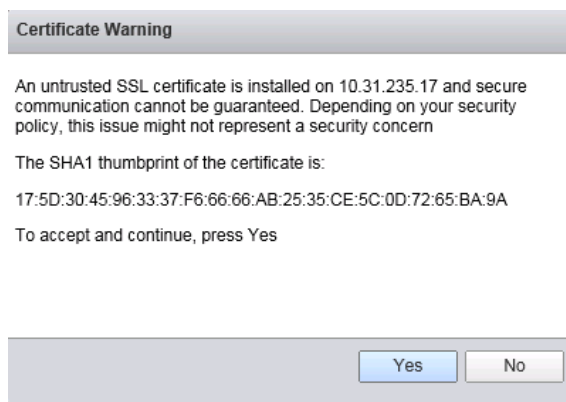


18. In this step you are selecting the vSphere host to install the VCSA on as a guest, this can be on a host running ESXi 5.5 or later. It is recommended that the vCenter server (Windows or appliance based) run on a separate management cluster from the one designated for VDI workloads. Enter the IP address or FQDN of the chosen host, then its root user name and password and click **[Next]**:

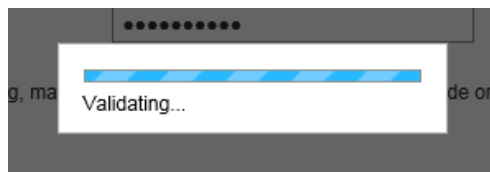




19. If your desktop, and the web installer, can reach the host then you should see a certificate warning as it connects, this is due to the use of a self-signed cert. If you are using signed certificates then you will not see this warning. Click **[Yes]** and continue:



20. The credentials you provided are validated:



21. With a successful connection you are now prompted to name the appliance, then enter a root password for the appliance, enter it twice and click next:

**VMware vCenter Server Appliance Deployment**

1 End User License Agreement  
2 Connect to target server  
**3 Set up virtual machine**  
4 Select deployment type  
5 Set up Single Sign-on  
6 Select appliance size  
7 Select datastore  
8 Configure database  
9 Network Settings  
10 Ready to complete

**Set up virtual machine**  
Specify virtual machine settings for the vCenter Server Appliance to be deployed.

Appliance name: vCenter Server Appliance 6.0

OS user name: root

OS password: [masked]

Confirm OS password: [masked]

Back Next Finish Cancel

22. Select a deployment type for your appliance. Since you are creating an instance for building your proof of concept, this should be a separate install of vCenter Server with an Embedded Platform Services Controller, choose that option and click **[Next]**:

**VMware vCenter Server Appliance Deployment**

1 End User License Agreement  
2 Connect to target server  
3 Set up virtual machine  
**4 Select deployment type**  
5 Set up Single Sign-on  
6 Select appliance size  
7 Select datastore  
8 Configure database  
9 Network Settings  
10 Ready to complete

**Select deployment type**  
Select the services to deploy onto this appliance.

vCenter Server 6.0 requires a Platform Services Controller, which contains shared services such as Single Sign-On, Licensing, and Certificate Management. An embedded Platform Services Controller is deployed on the same Appliance VM as vCenter Server. An external Platform Services Controller is deployed in a separate Appliance VM. For smaller installations, consider vCenter Server with an embedded Platform Services Controller. For larger installations with multiple vCenter Servers, consider one or more external Platform Services Controllers. Refer to product documentation for more information.

Note: Once you install vCenter Server, you can only change from an embedded to an external Platform Services Controller with a fresh install.

**Embedded Platform Services Controller**

☒ Install vCenter Server with an Embedded Platform Services Controller

**External Platform Services Controller**

☐ Install Platform Services Controller  
☐ Install vCenter Server

The diagram shows two architectures. The first, 'Embedded Platform Services Controller', shows a single box labeled 'VM or Host' containing both 'Platform Services Controller' and 'vCenter Server'. The second, 'External Platform Services Controller', shows a box labeled 'VM or Host' containing 'Platform Services Controller' connected to two separate boxes labeled 'VM or Host', each containing 'vCenter Server'.

Back Next Finish Cancel

23. Create a Single Sign-On instance, for the purposes of a proof of concept, enter (and confirm) a password, a domain name (we chose the default of vsphere.local), and a site name, then click **[Next]**:

**VMware vCenter Server Appliance Deployment**

- 1 End User License Agreement
- 2 Connect to target server
- 3 Set up virtual machine
- 4 Select deployment type
- 5 Set up Single Sign-on**
- 6 Select appliance size
- 7 Select datastore
- 8 Configure database
- 9 Network Settings
- 10 Ready to complete

**Set up Single Sign-on**  
Create or join a Single Sign-On domain. Single Sign-On configuration cannot be changed after deployment.

☒ Create Single Sign-On  
☐ Join a Single Sign-On domain in an existing vCenter 6.0 platform services controller

vCenter Single Sign-On User name: administrator

vCenter Single Sign-On Password:

Confirm password:

Domain name: vsphere.local

Site name: PSGSC

Back Next Finish Cancel

24. Select an appliance size, appropriate for the potential scale of your proof of concept or trial, here we selected small, then click **[Next]**:

**VMware vCenter Server Appliance Deployment**

- 1 End User License Agreement
- 2 Connect to target server
- 3 Set up virtual machine
- 4 Select deployment type
- 5 Set up Single Sign-on
- 6 Select appliance size**
- 7 Select datastore
- 8 Configure database
- 9 Network Settings
- 10 Ready to complete

**Select appliance size**  
Specify a deployment size for the new appliance

Appliance size: Small (up to 150 hosts, 3,000 VMs)

**Description**  
This will deploy a Small VM configured with 4 vCPUs and 16 GB of memory. Please note this option contains vCenter Server with an embedded Platform Services Controller.

Back Next Finish Cancel

25. Select a datastore from those available on the host you have connected with, also consider selecting Enable Thin Disk Mode, and then click **[Next]**:

**VMware vCenter Server Appliance Deployment**

- 1 End User License Agreement
- 2 Connect to target server
- 3 Set up virtual machine
- 4 Select deployment type
- 5 Set up Single Sign-on
- 6 Select appliance size
- 7 Select datastore**
- 8 Configure database
- 9 Network Settings
- 10 Ready to complete

**Select datastore**  
Select the storage location for this deployment.

The following datastores are accessible. Select the destination datastore for the virtual machine configuration files and all of the virtual disks.

Name	Type	Capacity	Free	Provisioned	Thin Provisioni...
datastore18	VMFS	924 GB	614.84 GB	367.85 GB	true

☐ Enable Thin Disk Mode

Back Next Finish Cancel

26. For a proof of concept environment, choose the embedded database, then click [Next]:

**VMware vCenter Server Appliance Deployment**

- 1 End User License Agreement
- 2 Connect to target server
- 3 Set up virtual machine
- 4 Select deployment type
- 5 Set up Single Sign-on
- 6 Select appliance size
- 7 Select datastore
- 8 Configure database**
- 9 Network Settings
- 10 Ready to complete

**Configure database**  
Configure the database for this deployment.

☒ Use an embedded database (vPostgres)  
☐ Use Oracle database

Oracle database server:   
 Oracle database port:   
 Instance name:   
 Database user name:   
 Database password:

Back Next Finish Cancel

27. Configure network settings, this is a long page and will require scrolling down to see all settings. Before configuring these settings, choose an appropriate static IP address and enter that into local DNS (e.g. on the Domain Controller). Once you can resolve the address, enter that IP address, host name, and then scroll down for remaining entries:

VMware vCenter Server Appliance Deployment

1 End User License Agreement  
 2 Connect to target server  
 3 Set up virtual machine  
 4 Select deployment type  
 5 Set up Single Sign-on  
 6 Select appliance size  
 7 Select datastore  
 8 Configure database  
**9 Network Settings**  
 10 Ready to complete

**Network Settings**  
 Configure network settings for this deployment.

Choose a network: VM Network

IP address family: ipv4

Network type: static

Network address: 10.31.235.28

System name [FQDN or IP address]: vcenterapp6.nvidia.lab

Subnet mask: 255.255.255.0

Network gateway: 10.31.235.1

Network DNS Servers separated by commas: 10.31.235.21, 10.31.235.22

Configure time sync:  
☐ Synchronize appliance time with host  
☒ Use NTP servers (Separated by commas)

Back Next Finish Cancel

28. Make sure your entire configuration leverages an NTP service, this includes the vCenter Server, ESXi hosts, VMs and Management components. The lower half of the Network Settings pane adds NTP, enter your local time server or a reachable external one, and click **[Next]**:

VMware vCenter Server Appliance Deployment

1 End User License Agreement  
 2 Connect to target server  
 3 Set up virtual machine  
 4 Select deployment type  
 5 Set up Single Sign-on  
 6 Select appliance size  
 7 Select datastore  
 8 Configure database  
**9 Network Settings**  
 10 Ready to complete

**Network Settings**  
 Configure network settings for this deployment.

Network type: static

Network address: 10.31.235.28

System name [FQDN or IP address]: vcenterapp6.nvidia.lab

Subnet mask: 255.255.255.0

Network gateway: 10.31.235.1

Network DNS Servers separated by commas: 10.31.235.21, 10.31.235.22

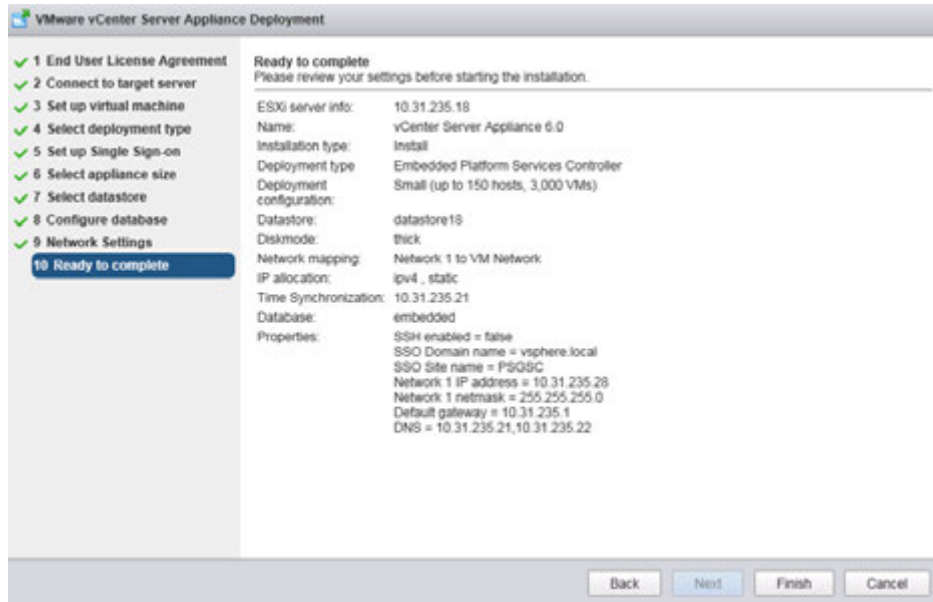
Configure time sync:  
☐ Synchronize appliance time with host  
☒ Use NTP servers (Separated by commas)  
 10.31.235.21

☐ Enable ssh

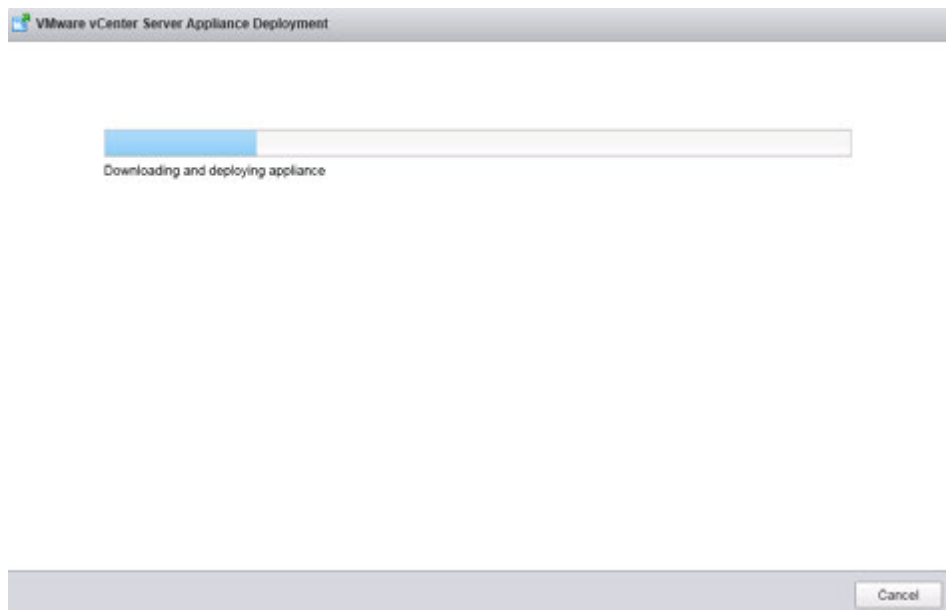
Before proceeding make sure there is time synchronization between ESXi host and the NTP servers. If not, deployment will fail.

Back Next Finish Cancel

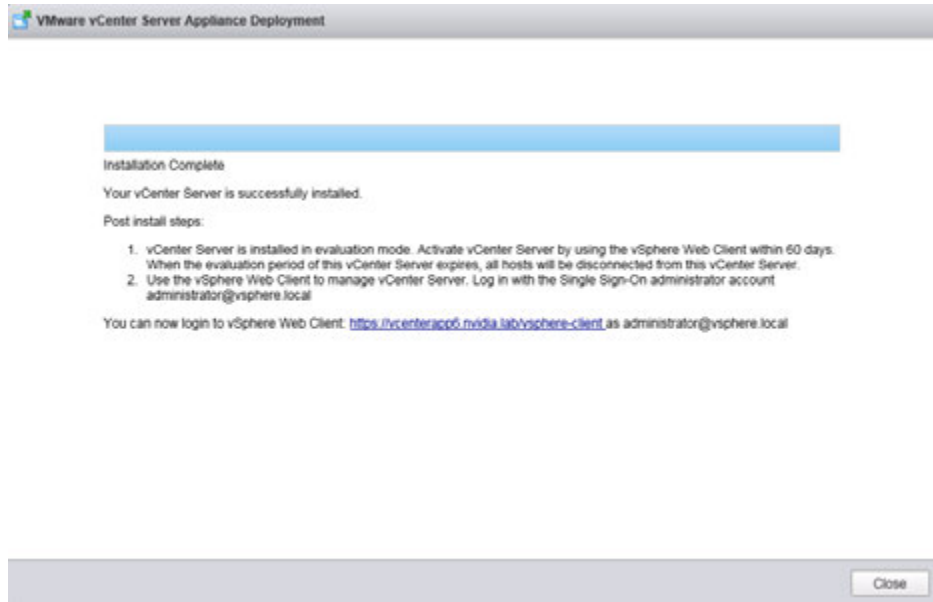
29. Confirm your settings and if correct click **[Finish]** to deploy your vCenter server:



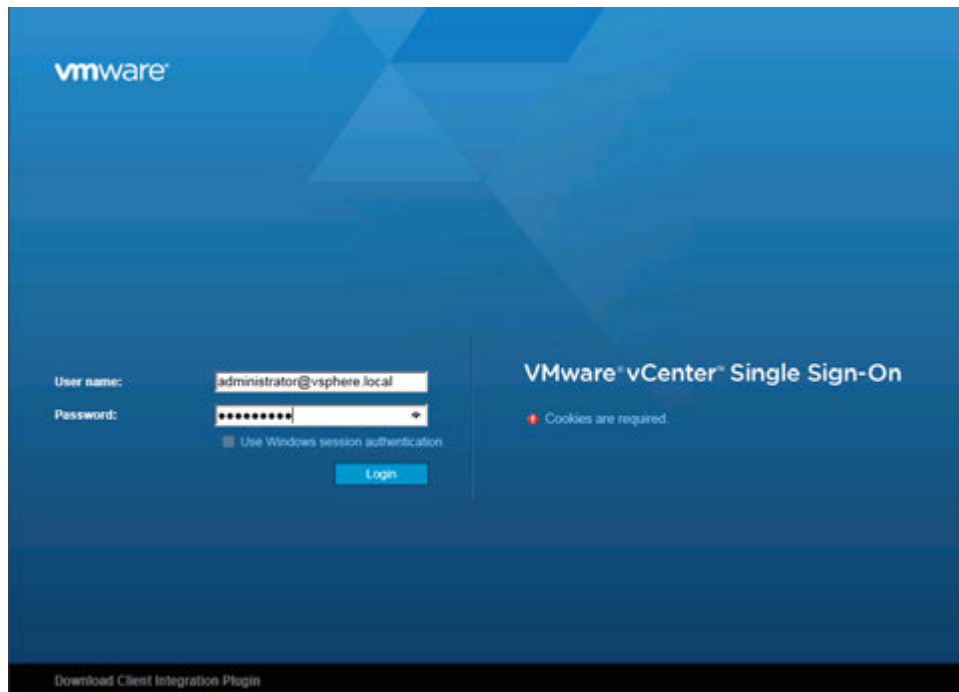
30. If all settings are correct then you should see a progress bar:



31. When complete the window below appears with a link to your VCSA, click the link to reach the login page. You can now close this page:



32. The VCSA is now installed and ready for use. From your browser the login page should look like this (be sure to enable cookies if you have not):



## 4.2 INSTALLING VCENTER 6 SERVER ON WINDOWS SERVER 2012

This section describes how to install and configure vCenter 6 Server.

### 4.2.1 Initial Installation

Use the following procedure to install vCenter 6 Server:

1. Mount the VMware ISO with the installation media in the drive
2. Right-click the drive and select **Install or run program** from your media.  
The *VMware vCenter Installer* window displays.
3. Select **vCenter Server for Windows** and click **Install**.  
The Welcome window displays.
4. Click **Next** to proceed with the installation.  
The *End User License Agreement* window displays.
5. Check **I accept the terms of the license agreement** checkbox,
6. Click **Next** to proceed.  
The *Deployment Type* window displays.
7. Select **vCenter Server with an embedded infrastructure controller**.
8. Click **Next** to proceed.  
The *System Network Name* window displays.
9. Enter the name or IP address of the host in the **System Name** field,
10. Click **Next** to proceed.  
The *Single Sign-On Configuration* window displays.



A warning dialog displays if you enter an IP address; click **OK** to proceed.

11. Enter the administrator password for the new Single Sign- On domain in the **Password** and **Confirm password** fields
12. Click **Next** to proceed.  
The *vCenter Server Service Account* window displays.



**CAUTION:** TO PREVENT UNAUTHORIZED ACCESS, YOUR SELECTED ROOT PASSWORD SHOULD CONTAIN AT LEAST EIGHT (8) CHARACTERS AND CONSIST OF A MIX OF LOWERCASE AND CAPITAL LETTERS, DIGITS, AND SPECIAL CHARACTERS



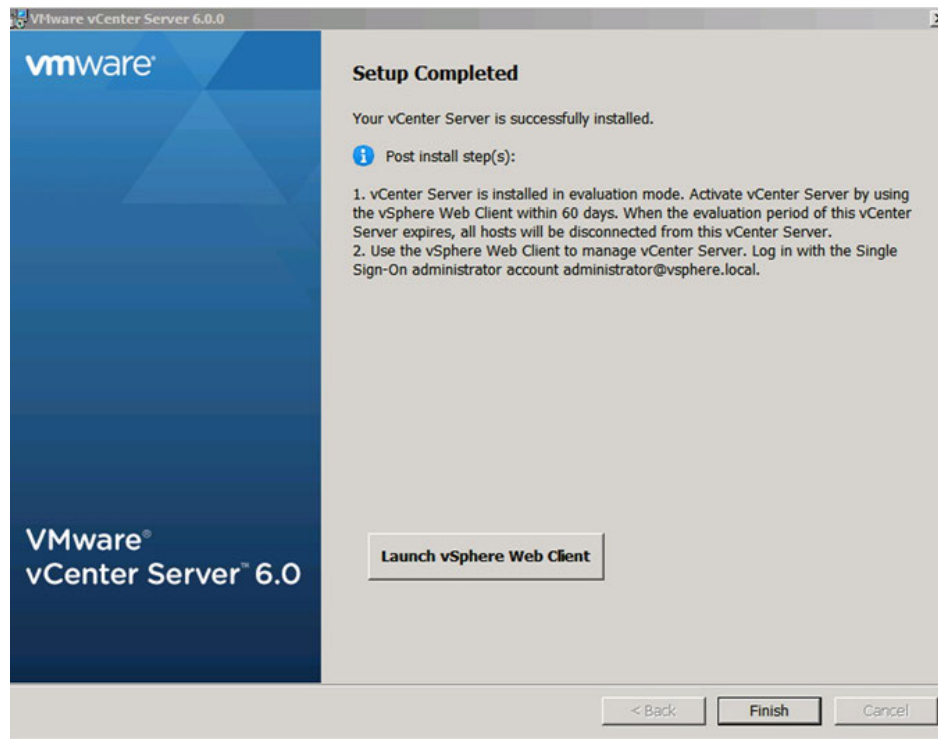
13. Select **Use Windows Local Account**.
14. Click **Next** to proceed.  
The *Database Settings* window displays.
15. Select **Use an embedded database (vPostgres)**,
16. Click **Next** to proceed.  
The *Configure Ports* window displays. The values shown are the default values; you should not have to modify any of them.

Section	Port Name	Default Value
Common Ports	HTTP Port:	80
	HTTPS Port:	443
	Syslog Service Port:	514
	Syslog Service TLS Port:	1514
Platform Services Controller Ports	Secure Token Service Port:	7444
vCenter Server Ports	Auto Deploy Management Port:	6502
	Auto Deploy Service Port:	6501
	ESXi Dump Collector Port:	6500
	ESXi Heartbeat Port:	902
	vSphere Web Client Port:	9443

Some ports are not configurable. To proceed, make the following ports available:  
88, 389, 636, 2012, 2014, 2020, 11711, and 11712

17. Ensure that the ports are configured as shown in the *Configure Ports* window and click **Next** to proceed. The *Destination Folder* window displays.
18. Accept the suggested path or enter a custom path.
19. Click **Next** to proceed.  
The *Ready to Install* window displays.

20. Verify that all of the selections are correct and click **Next** to proceed.  
The installation takes place. The *Setup Completed* window displays once the installation is completed.

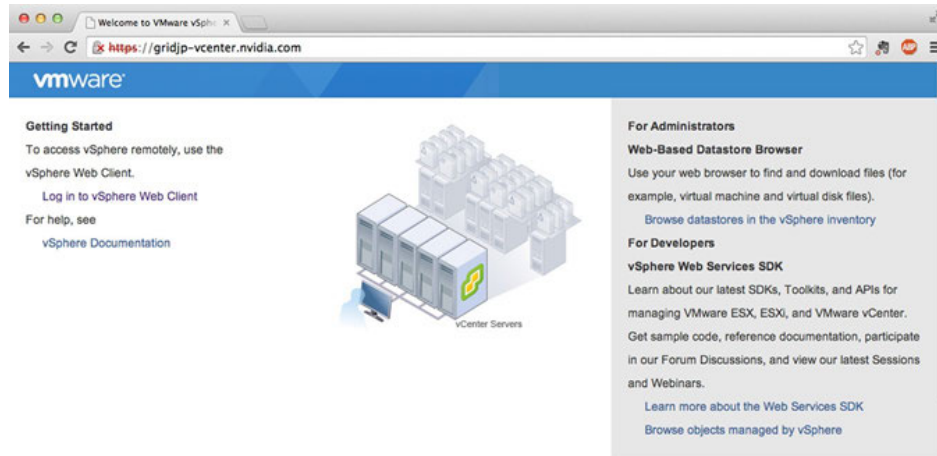


21. Click **Finish** to complete the installation process
22. Connect to the host using the Web client, using your Single Sign-On credentials.

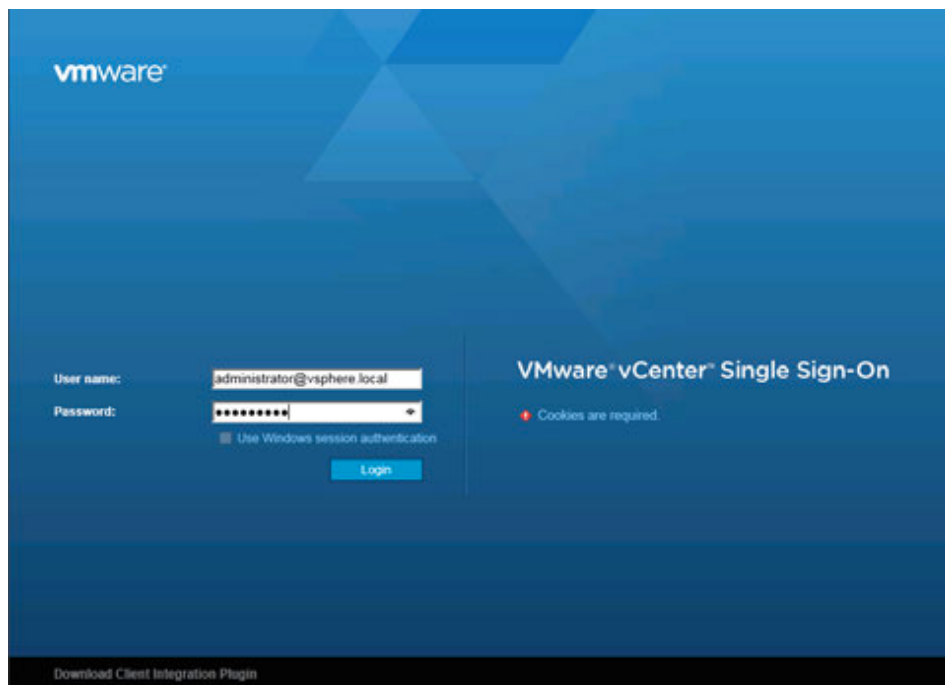
## 4.2.2 Adding Licenses to your vCenter Server

Use the following procedure to configure vCenter 6:

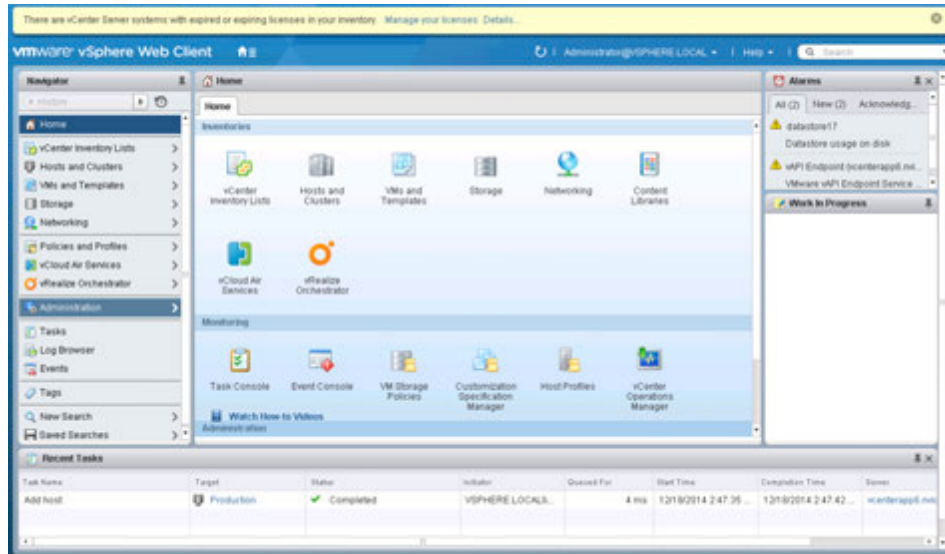
1. Open a web browser and navigate to the vCenter host at **https://<host>**, where **<host>** is either the hostname or IP address. Ignore the untrusted certificate warning if it displays. The *Getting Started* page displays, select **Log in to vSphere Web client**:



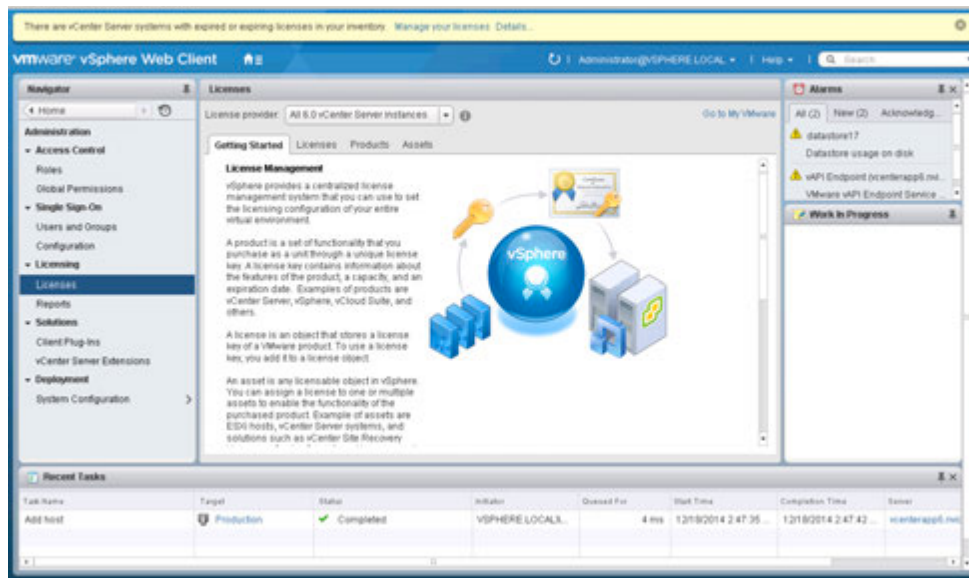
2. Install the VMware Client Support Plug-in by selecting **Always run on this site**, if prompted. The *VMware Single Sign-On* page displays:



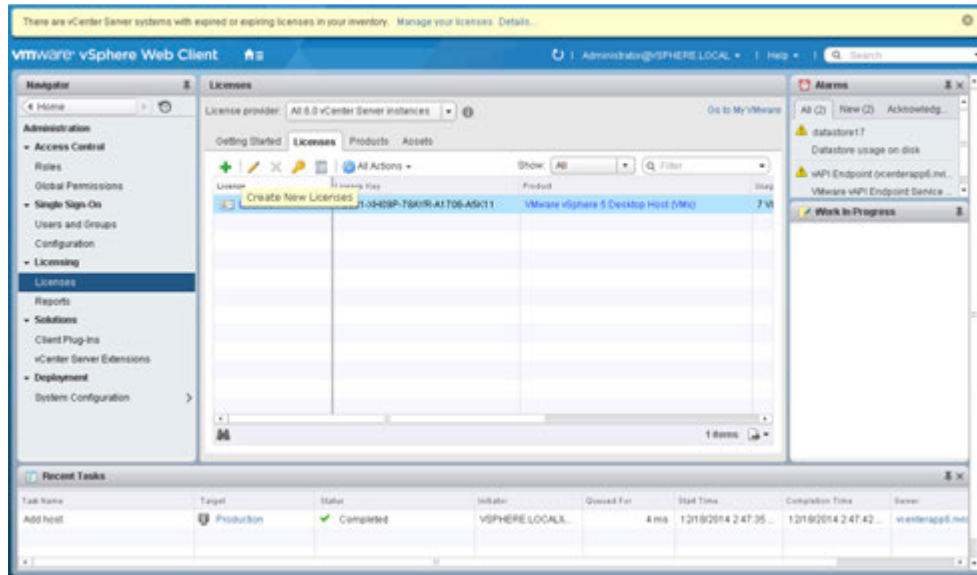
3. Enter the username and password that you specified during installation, and then click the **Login** button. The *VMware vSphere Web Client* page displays.



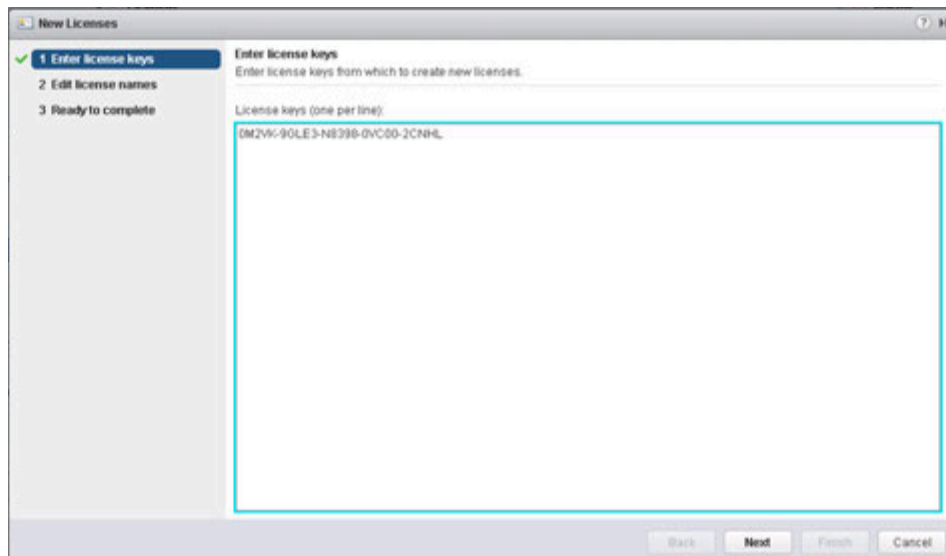
- Click the **Home** icon (house) and then select **Administration**. The *Administration* page displays.



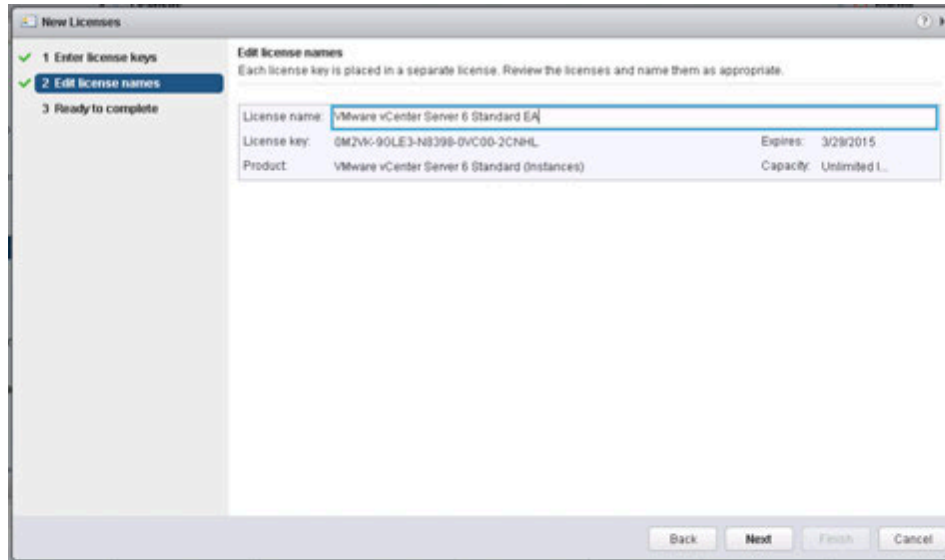
- Select **Licenses** from the left-hand menu and then select the **Licenses** tab to open the **Licenses** tab. Click the green **New License** icon (plus sign) to open the *New Licenses* popup.



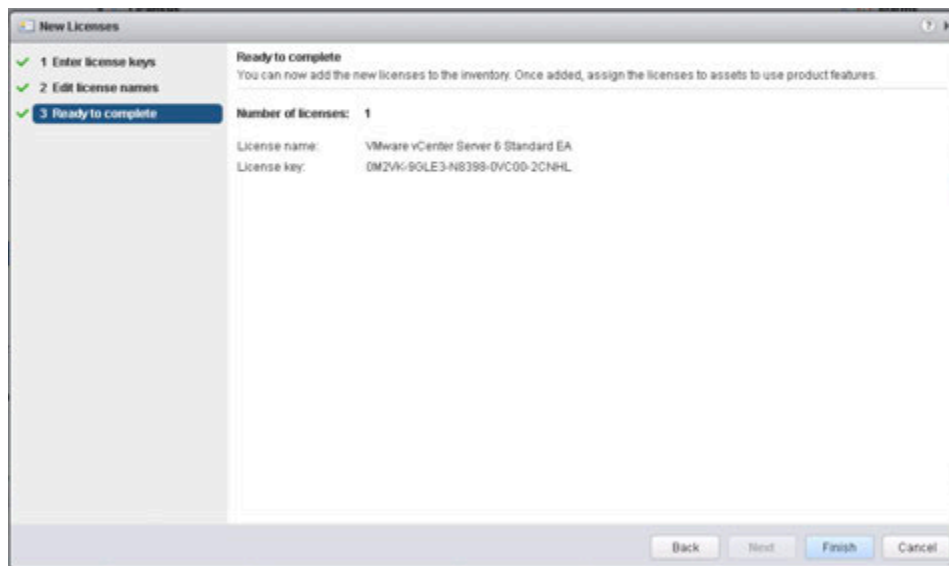
6. Enter the Center Server Standard license key



7. Enter a unique name for the license in the **License Name** field and then click **Next**.



8. Review your selections and then click **Finish** to close the *Enter New License* popup and return to the VMware vSphere Web Client page.

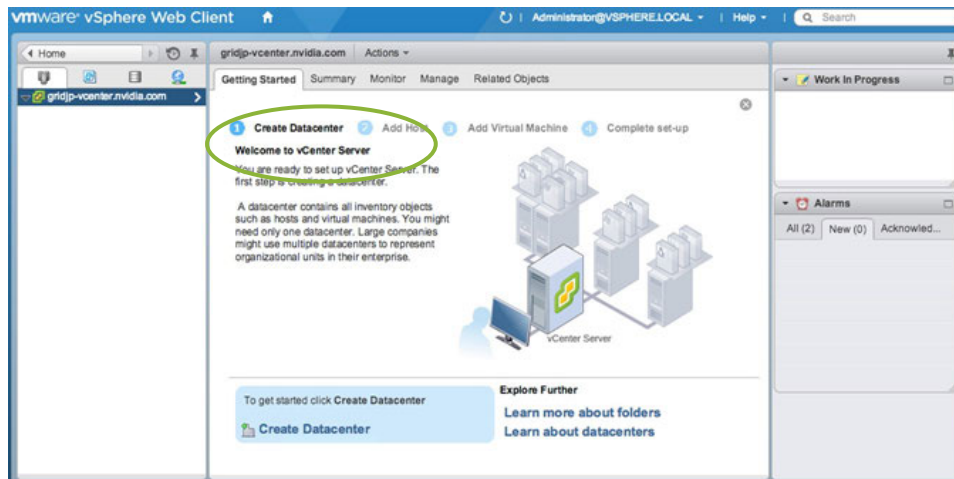


### 4.2.3 Adding a Host

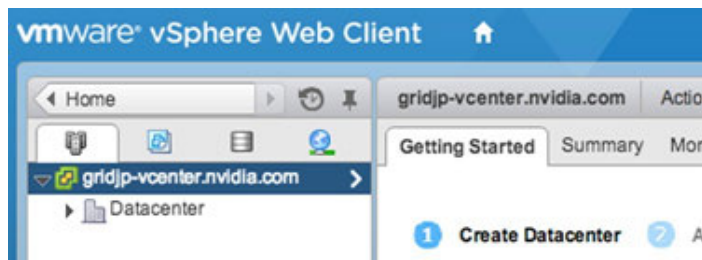
Use the following procedure to add a host in vCenter 6:

1. Select the **Home** icon (house) on the *VMware vSphere Web Client* page
2. Select **Hosts and Clusters**.
3. Select the desired host.

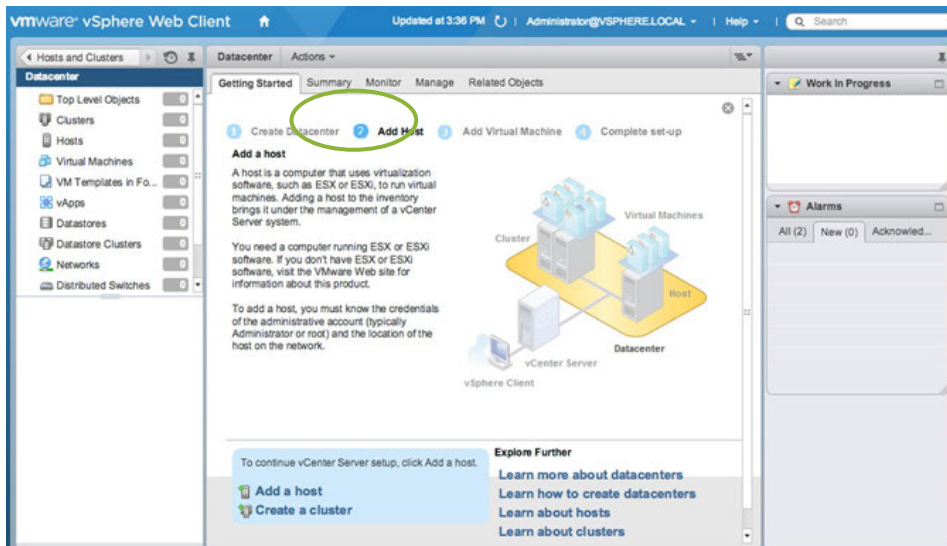
4. Go to the **Getting Started** tab and select **Create Datacenter**.  
The New Datacenter popup Displays



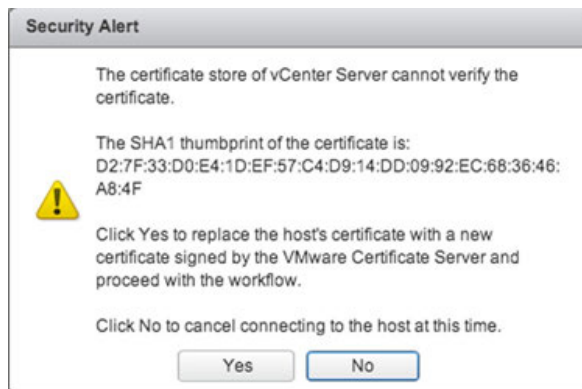
5. Enter a name for the datacenter in the **Datacenter name** field and click **OK**.  
The new datacenter is visible in the left panel of the *vSphere Web Client*.



Select the **Getting Started** tab and select **Add a Host**.  
The *Name and location* dialog opens.



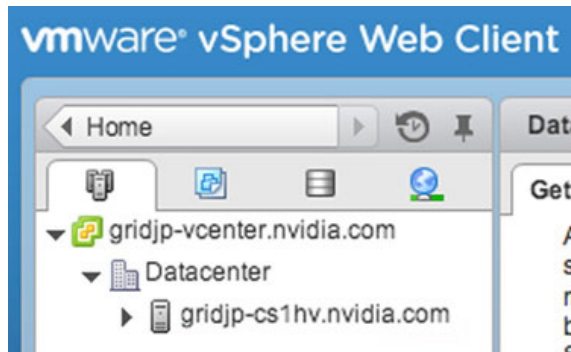
6. Enter the host name or IP address of the vSphere host and click **Next**.  
The *Connection settings* dialog displays.
7. Enter the administrator account credentials in the **User name** and **Password** fields and click **Next**. The *Security Alert* popup displays.



8. Click **Yes** to replace the host certificate.  
The *Host summary* dialog displays.
9. Review the settings and click **Next** to proceed.  
The *Assign license* dialog displays.
10. Confirm the license selection and click **Next**.  
The *Lockdown mode* dialog displays.
11. Accept the default setting (Disabled) and click **Next**.  
The *VM location* dialog displays.

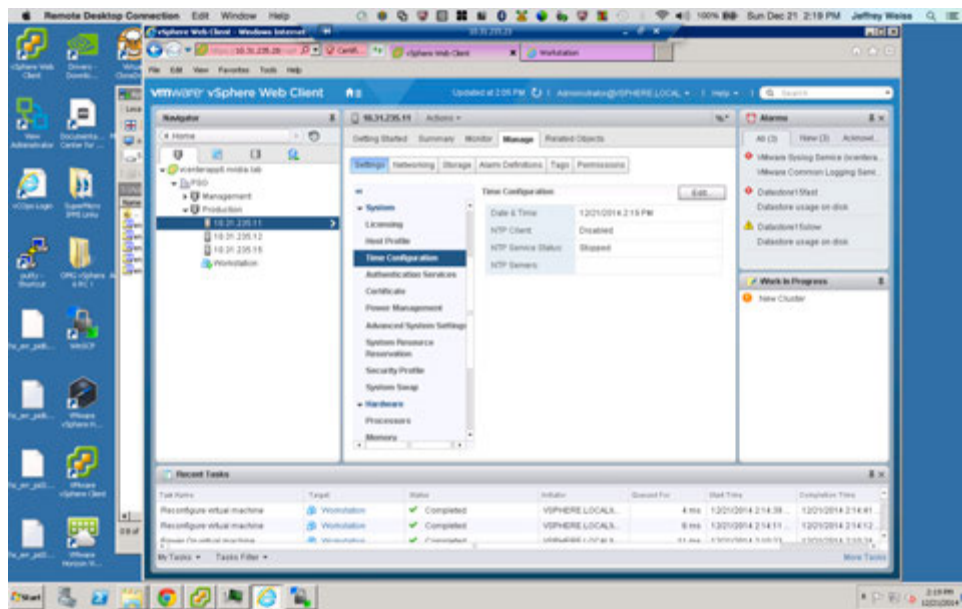


12. Select a cluster or accept the default option and click **Next** to proceed.  
The *Ready to complete* dialog displays.
13. Click **Finish** to complete adding the new host.  
The new host is now visible in the left panel when you click the datacenter name.

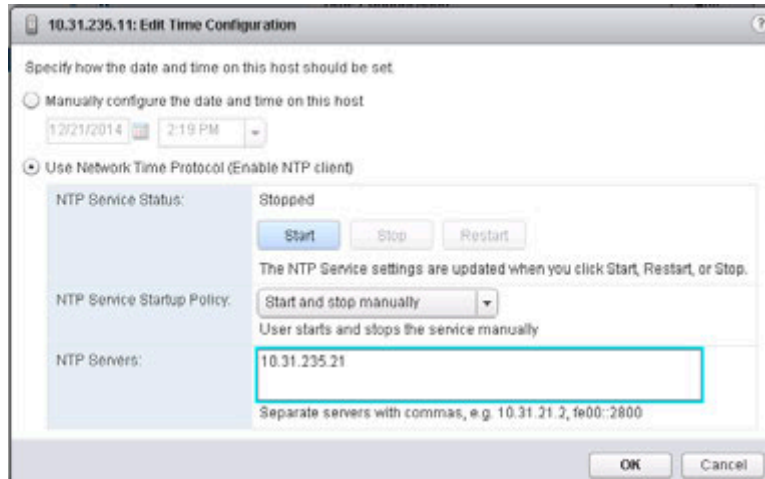


#### 4.2.4 Setting the NTP service on a host

1. Click a host object in the menu on the left, click **Manage** → **Settings** → **Time Configuration** → **Edit**



2. Enter a valid time server and click **OK**:



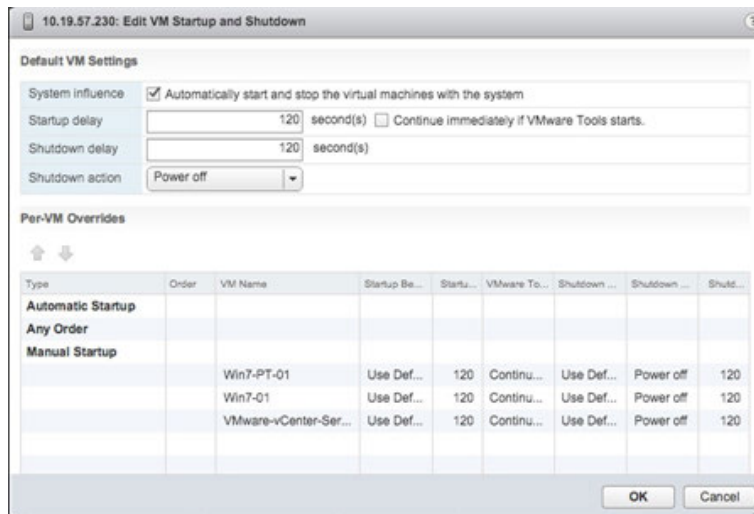
3. Do this for each host to ensure time is accurate for all guests.

## 4.2.5 Setting a vCenter Appliance to Auto-Start

Use the following procedure to set a vCenter Appliance to start automatically:

1. In the vSphere Web Client, select the host then select **Manage** → **VM Startup/Shutdown**.
2. Click the **Edit** button.

The *Edit VM Startup and Shutdown* window displays.



3. Select the **vCenter Appliance** and click the **Up** arrow to move that virtual machine up to the **Automatic Startup** section

4. Select the following options:
  - Set Startup Behavior to Custom and select Continue immediately if VMware Tools starts
  - Set Startup Delay to 0
  - Set Shutdown Behavior to Custom
  - Select Guest Shutdown

10.19.57.230: Edit VM Startup and Shutdown

**Default VM Settings**

System influence ☒ Automatically start and stop the virtual machines with the system

Startup delay  second(s) ☒ Continue immediately if VMware Tools starts.

Shutdown delay  second(s)

Shutdown action

**Per-VM Overrides**

Type	Order	VM Name	Startup Be...	Startu...	VMware To...	Shutdown ...	Shutdown ...	Shuld...
<b>Automatic Startup</b>	1	VMware-vCenter-Ser...	Custom	0	Continu...	Custom	Guest s...	120
<b>Any Order</b>								
<b>Manual Startup</b>		Win7-PT-01	Use Def...	120	Continu...	Use Def...	Power off	120
		Win7-01	Use Def...	120	Continu...	Use Def...	Power off	120

OK Cancel

5. Click **OK** to apply the configuration.

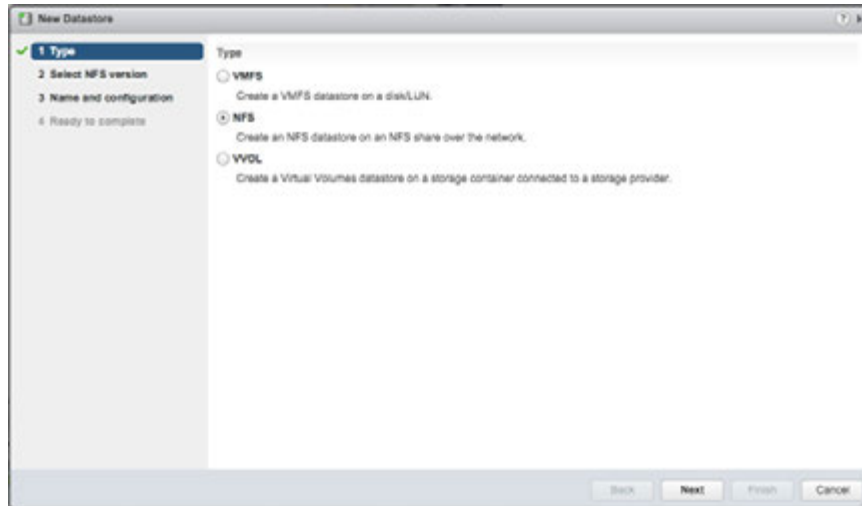


The vCenter Web Client may not reflect these configuration changes immediately. Either click the **Refresh** icon or different configuration group and return to the current setting.

## 4.2.6 Mounting an NFS ISO Data Store

Use the following procedure to mount an NFS ISO data store:

1. In the main *vSphere Web Client* window, select **Hosts and Clusters** and select the host.
2. Select **Storage** → **New Datastore** from the **Actions** drop-down menu.  
The *New Datastore* window displays with the **Type** tab selected.



3. Select **NFS** and click **Next** to proceed.  
The **Select NFS version** tab displays.
4. Select the correct NFS version and click **Next** to proceed.  
The **Name and configuration** tab displays.
5. Enter the NFS exported folder path and the NFS server address in the **Folder** and **Address** fields, respectively.  
Since this is an ISO data store, consider mounting it as read-only by checking the **Mount NFS as read-only** checkbox.
6. Click **Next** to proceed.  
The **Host accessibility** tab displays.
7. Select the host that will use the new data store,

8. Select **Next** to proceed.  
The **Ready to complete** tab displays.

The screenshot shows the 'New Datastore' wizard in VMware vCenter. The left sidebar lists six steps, with '6 Ready to complete' selected and highlighted in blue. The main area displays the following configuration:

**General:**

- Name: ISO Datastore
- Type: NFS
- Version: NFS 3

**NFS share and access mode:**

- Server: 10.19.57.67
- Folder: /mnt/nas/lao
- Access Mode: Read-only

**Hosts that will have access to this datastore:**

Host	Cluster
10.19.57.230	

At the bottom right, there are four buttons: 'Back', 'Next', 'Finish', and 'Cancel'.

9. Review the settings.
10. Click **Finish** to complete adding the NFS ISO data store.  
This data store is now accessible as an installation source for virtual machine CD drives.

# Chapter 5.

## NVIDIA vGPU MANAGER VIB INSTALLATION

This chapter discusses the following NVIDIA vGPU Manager **VIB** installation topics:

- ▶ Step-by-step guide to downloading and preparing the VIB file for installation on the host.
  - VIB file upload using either vSphere Web Client (see section 5.1.1, Uploading VIB in vSphere on page 59)
  - WinSCP (see Chapter 15, *Using WINS SCP*), on page 225)
- ▶ Installing the **VIB**.
- ▶ Uninstalling the **VIB**.
- ▶ NOTE: Upgrading from previous versions of the VIB is not supported.

### 5.1 PREPARING THE VIB FOR INSTALL

Use the following procedure to prepare the **VIB** file:

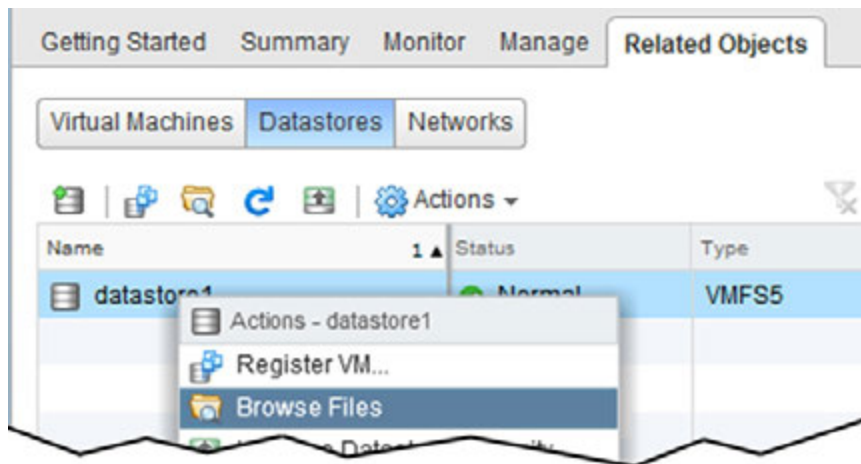
1. Download the archive containing the **VIB** file.
2. Extract the contents of the archive to a folder. The file ending with **VIB** is the file that you must copy to the host data store for installation.

#### 5.1.1 Uploading VIB in vSphere

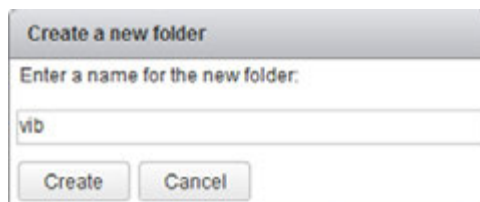
This section describes how to upload a .VIB file to the host using the vSphere Web Client. See Chapter 15, *Using WINS SCP*, on page 225 if you are using WinSCP.

To upload the file to the data store using vSphere Web Client:

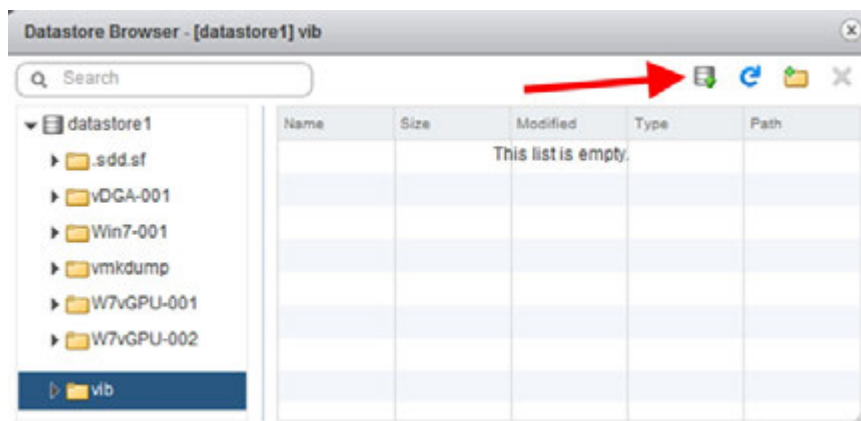
1. Click the **Related Objects** tab for the desired server
2. Select **Datastores**.
3. Either right click the data store and then select **Browse Files**, or click the icon in the toolbar. The *Datastore Browser* window displays.



4. Click the **New Folder** icon.  
The *Create a new folder* window displays.
5. Name the new folder **vib** and then click **Create**.



6. Select the **vib** folder in the *Datastore Browser* window.
7. Click the **Upload** icon.



The *Client Integration Access Control* window displays.

8. Select **Allow**.

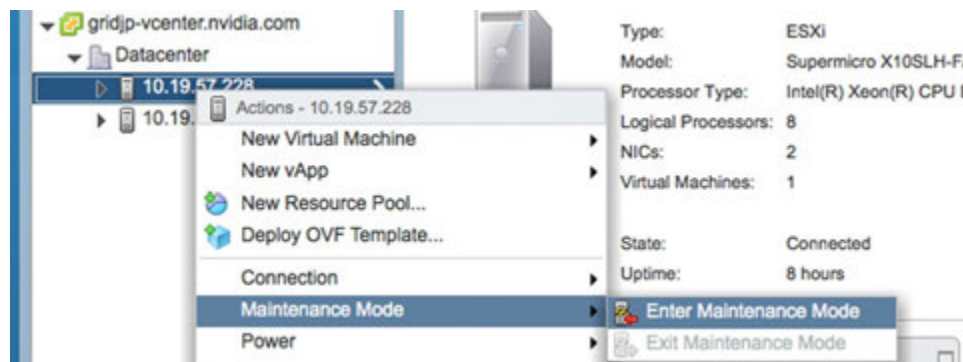
The .VIB file is uploaded to the data store on the host.

If you do not click **Allow** before the timer runs out, then further attempts to upload a file will silently fail. If this happens, exit and restart vSphere Web Client, Repeat this procedure and be sure to click **Allow** before the timer runs out.

## 5.2 PREPARE AND INSTALL THE VIB FILE

This section guides you through preparing, installing, and confirming the **VIB** file.

1. Upload the **VIB** file to the host using either the vSphere Web Client Utility (see the following sections for more detailed information: see section 5.1.1, Uploading VIB in vSphere on page 59; Chapter 15, *Using WINSCP*, on page 225)
2. Place the host into Maintenance mode by right-clicking it and then selecting **Maintenance Mode** → **Enter Maintenance Mode**.



Alternatively, you can place the host into Maintenance mode using the command prompt by entering

```
$ esxcli system maintenanceMode set -- enable=true
```

This command will not return a response. Making this change using the command prompt will not refresh the vSphere Web Client UI. Click the **Refresh** icon in the upper right corner of the vSphere Web Client window.



**CAUTION:** PLACING THE HOST INTO MAINTENANCE MODE DISABLES ANY VCENTER APPLIANCE RUNNING ON THIS HOST UNTIL YOU EXIT MAINTENANCE MODE AND THEN RESTART THAT VCENTER APPLIANCE.



3. Click **OK** to confirm your selection.

## 5.2.1 Installing the VIB

Use the following procedure to install the **VIB** file, NVIDIA-vgx-VMware-346.27-1OEM.600.0.0.2159203.x86\_64.vib:

1. Issue the following command to install the vGPU VIB, where **<path>** is the full path to the VIB file:

```
$ esxcli software vib install --no-sig-check
-v /<path>/NVIDIA-vgx-VMware-346.27-1OEM.600.0.0.2159203.x86_64.VIB
```

The following error displays if you *do not* use the full path:

**[VibDownloadError]**.

When the installation is successful, the following displays:

```
Installation Result:
Message: Operation finished successfully. Reboot Required: false
VIBs Installed: NVIDIA_bootbank_NVIDIA-vgx-
VMware_vSphere_6_Host_Driver_346.27-1OEM.600.0.0.2159203
VIBs Removed: VIBs Skipped:
```



Although the display states “**Reboot Required: false**”, a reboot is necessary for the vib to load and xorg to start.

2. From the vSphere Web Client, exit **Maintenance Mode** by right-clicking the host and selecting **Exit Maintenance Mode**.



Alternatively, you may exit from Maintenance mode via the command prompt by entering:  
**\$ esxcli system maintenanceMode set -- enable=false**

This command will not return a response.

Making this change via the command prompt will not refresh the vSphere Web Client UI. Click the **Refresh** icon in the upper right corner of the vSphere Web Client window.

3. Reboot the host from the vSphere Web Client by right-clicking the host and then selecting **Reboot**.



You can reboot the host by entering the following at the command prompt:

**\$ reboot**

This command will not return a response. The Reboot Host window displays.

When rebooting from the vSphere Web Client, enter a descriptive reason for the reboot in the **Log a reason for this reboot operation** field, and then click **OK** to proceed.

## 5.2.2 Confirm the VIB Installation

1. Use the following command to determine the installation of vGPU driver in vSphere:

```
$ esxcli software vib list | grep -i nvidia
```

This command returns output similar to the following:

```
NVIDIA-vgx-VMware_vSphere_6_Host_Driver 346.27-10EM.600.0.0.2159203
NVIDIA VMwareAccepted 2014-12-30
```

2. Confirm GPU detection using the following command:

```
$ nvidia-smi
```

This command returns output similar to the following (output shown below is for a pair of K2 cards in a single host):

```
+-----+
| NVIDIA-SMI 346.27 Driver Version: 346.27 |
+-----+-----+-----+-----+
| GPU Name Persistence-M | Bus-Id Disp.A | Volatile Uncorr. ECC |
| Fan Temp Perf Pwr:Usage/Cap | Memory-Usage | GPU-Util Compute M. |
+-----+-----+-----+-----+
|====+=====+=====+=====+
| 0 GRID K2 Off|0000:09:00.0 Off| Off |
| N/A 52C P8 30W / 117W |917MiB/4095MiB | 7% Default |
+-----+-----+-----+-----+
| 1 GRID K2 Off|0000:0A:00.0 Off| Off |
| N/A 43C P0 50W / 117W |11MiB/4095MiB | 0% Default |
+-----+-----+-----+-----+
| 2 GRID K2 Off|0000:85:00.0 Off| Off |
| N/A 42C P0 51W / 117W|11MiB /4095MiB | 0% Default |
+-----+-----+-----+-----+
| 3 GRID K2 Off|0000:86:00.0 Off| Off |
| N/A 37C P0 39W / 117W| 11MiB /4095MiB | 0% Default |
+-----+-----+-----+-----+

+-----+
| Compute processes: GPU Memory |
| GPU PID Process name Usage |
+=====+
| No running compute processes found |
+-----+
```

If the **nvidia-smi** command does not return any output (see Chapter 14, *Troubleshooting*, on page 210)

3. SMI also allows GPU monitoring using the following command:

```
$ nvidia-smi -l
```

This command switch adds a loop, auto refreshing the display.

## 5.3 UNINSTALLING THE VIB

This section describes how to uninstall the **VIB**. NOTE: Upgrading is not supported.

### 5.3.1 Uninstalling VIB

Use the following procedure to uninstall **VIB**:

1. Determine the name of the vGPU driver bundle as described in section 5.2.2, *Confirm the VIB Installation*, on page 63
2. Run the following command to uninstall the driver package:

```
$ esxcli software vib remove -n NVIDIA-vgx-  
VMware_vSphere_6_Host_Driver --maintenance-mode
```

The following message displays when installation is successful:

```
Installation Result:  
Message: Operation finished successfully. Reboot Required: false  
VIBs Installed:  
VIBs Removed: NVIDIA_bootbank_NVIDIA-vgx-  
VMware_vSphere_6_Host_Driver_340.49- 1OEM.600.0.0.1951118  
VIBs Skipped:
```

3. Reboot the host to complete the uninstallation process.

# Chapter 6.

## BUILDING HORIZON 6.1

This chapter covers installing VMware Horizon 6, including:

- ▶ Building Horizon 6.1
- ▶ Registering the license
- ▶ Registering a vCenter Server
- ▶ Installing a Horizon View Composer Server
- ▶ Registering a Horizon View Composer Server

## 6.1 INSTALLING HORIZON 6.1

The server on which you are installing Horizon View must meet the requirements listed in “General Prerequisites” on page 15. As of the publication date of this manual the current version of the View Connection Server is:

VMware-viewconnectionserver-x86\_64-e.x.p-2337195.exe

Use the following procedure to install Horizon 6.1:

1. Launch the installer to display the **Welcome to the Installation Wizard** window.

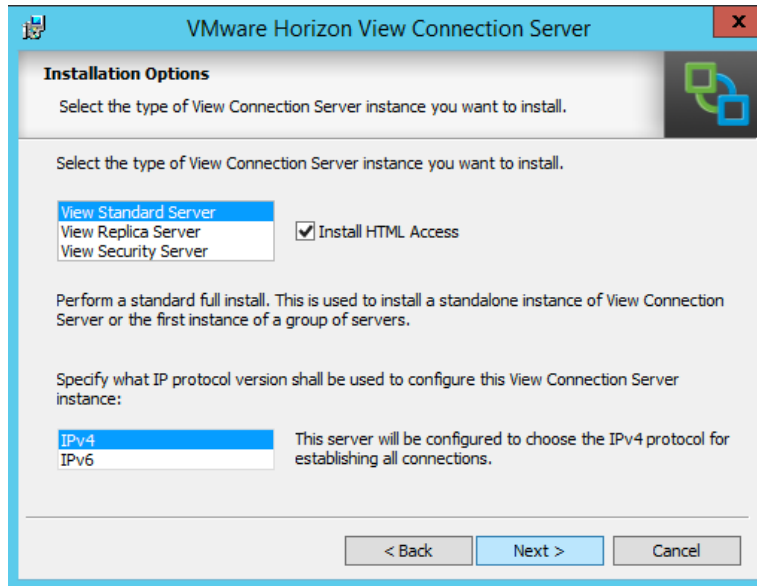


2. Select **Next** to display the **End User License Agreement** window.



3. Check **I accept the terms of the license agreement** radio button to accept the agreement. Select **Next** to continue.

4. The Destination Folder window allows you to choose an install location and click **Next**.
5. Select **View Standard Server** with the **Install HTML Access** checkbox checked and **IPv4** selected:



6. Select **Next** to continue.  
If you are upgrading a server that hosted Horizon 5.3, a popup message may display with the message:  
**At least one Directory Services instance for the Horizon Connection Server already exists on this system.**
7. Select **OK** to close the popup and continue the installation.  
The **Data Recovery** window displays.

8. Enter a password in the **Enter data recovery password** and **Re-enter password** fields,
  9. Select **Next** to continue.
- The Firewall Configuration window displays.

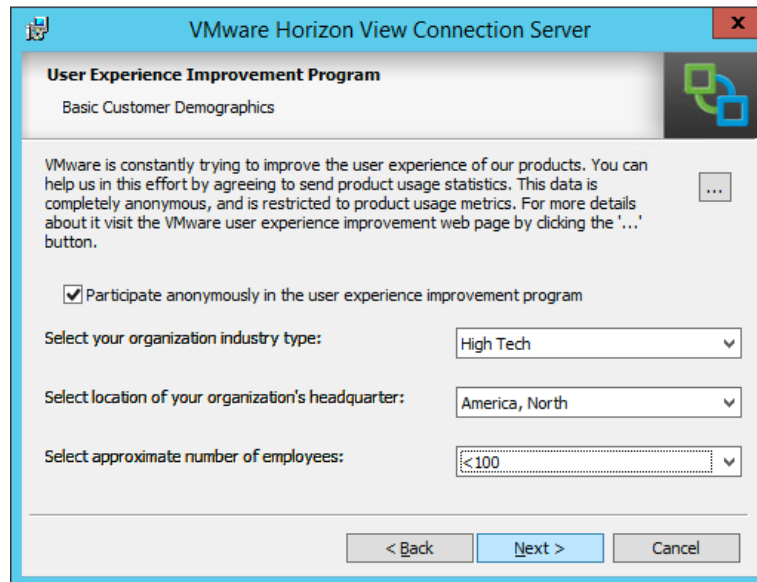


**CAUTION:** TO PREVENT UNAUTHORIZED ACCESS, YOUR SELECTED ROOT PASSWORD SHOULD CONTAIN AT LEAST EIGHT (8) CHARACTERS AND CONSIST OF A MIX OF LOWERCASE AND CAPITAL LETTERS, DIGITS, AND SPECIAL CHARACTERS.

10. Check the **Configure Windows Firewall automatically** checkbox
  11. Select **Next** to continue.
- The *Initial Horizon View Administrators* window displays.

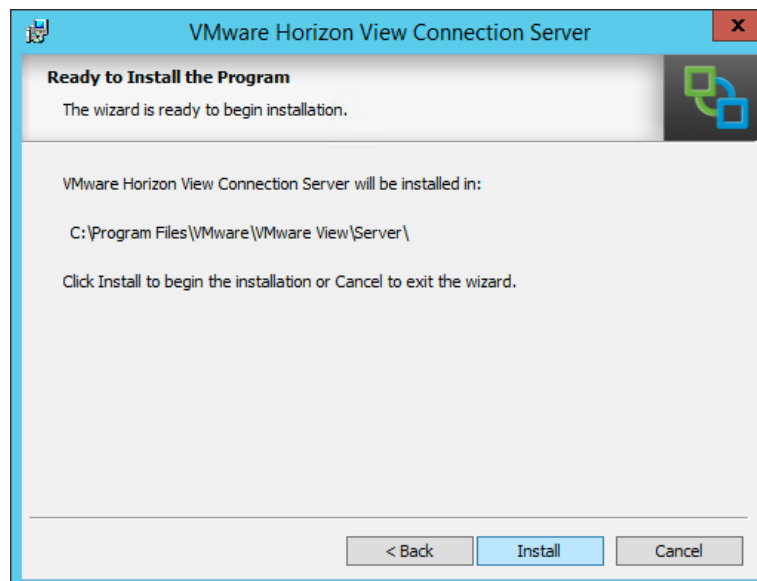
12. Select either the local Administrators group or a specific domain user or group, as appropriate.
13. Select **Next** to continue.

The **User Experience Improvement Program** window displays



14. Choose your option for the **Participate anonymously in the user experience improvement program** checkbox.
15. Select **Next** to continue.

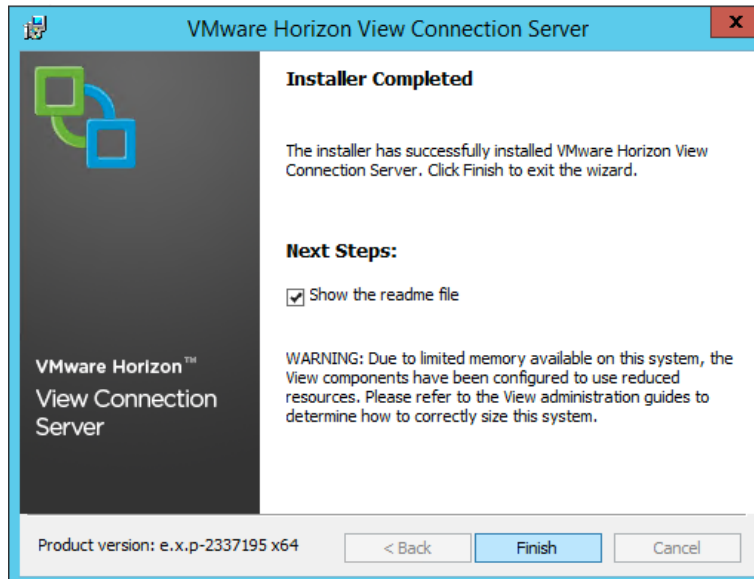
The **Ready to Install the Program** window displays.



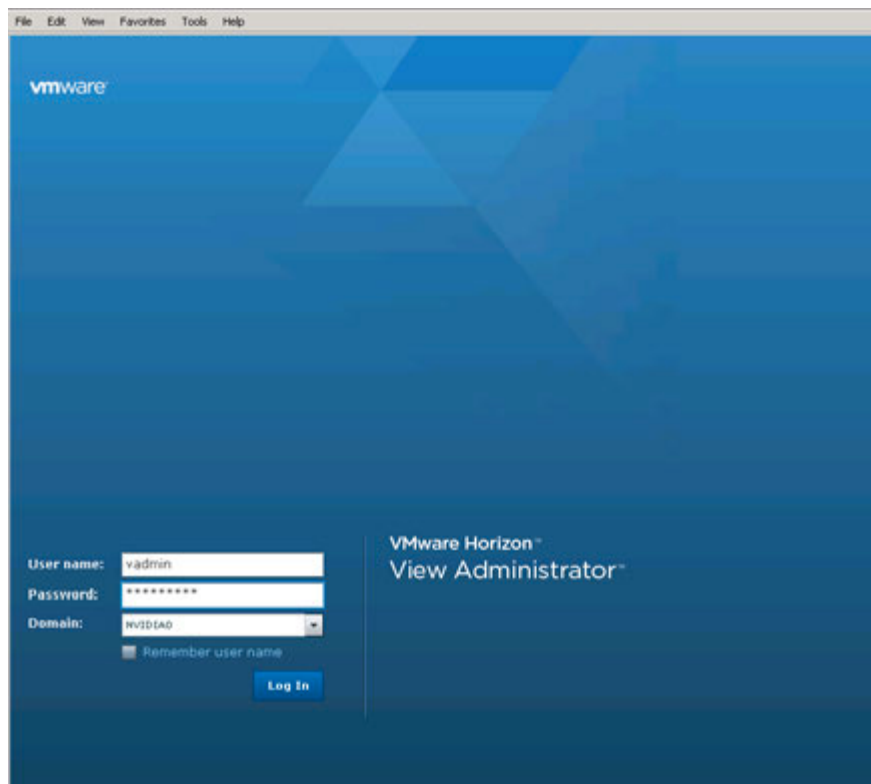
16. Select **Install** to complete the installation.



17. Select **Finish** when the *Installer Completed* window display.



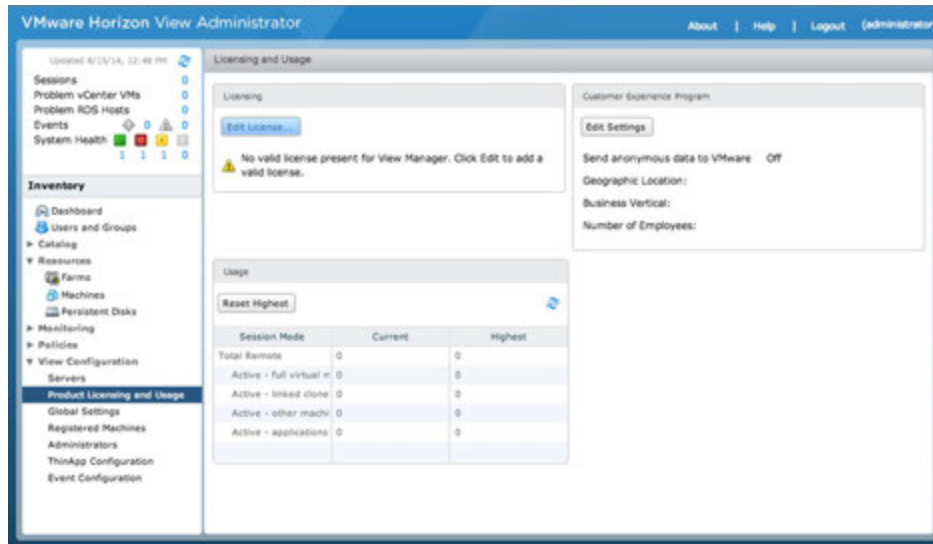
18. Browse to the IP address or hostname of the server you installed on using **https://<IP address>/admin:**



## 6.2 REGISTERING THE VIEW LICENSE

Use the following procedure to register the View license:

1. Connect to the View web console.  
The **View Administrator** page displays.
2. Select **View Configuration** → **Product Licensing and Usage** in the left pane.  
The **Licensing and Usage** window displays.



3. Select **Edit License**.  
The **Edit License** popup displays.

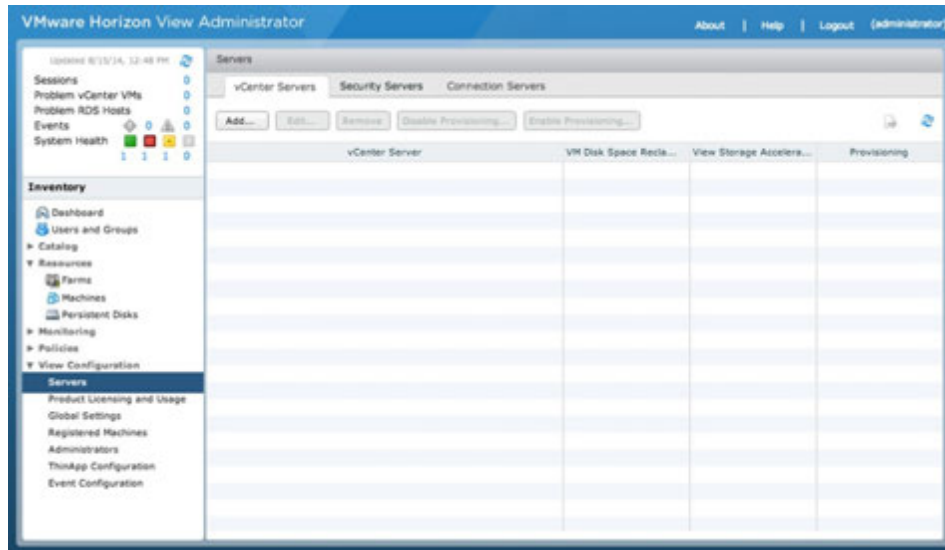


4. Enter your license key in the **License serial number** field
5. Click **OK** to decode and apply your license.
6. Verify that the license is enabled by looking for the **Enabled** messages in the **Licensing** area of the **Licensing and Usage** window.

## 6.3 REGISTERING VCENTER SERVER

Use the following procedure to register a vCenter server:

1. Select **Horizon Configuration** → **Servers** in the left pane of the **Horizon Administrator** page to display the **Servers** window.



2. Select **Add...** to register a new vCenter server.  
The **Add vCenter Server** popup displays with the **VC Information** tab selected.

**Add vCenter Server**

**VC Information**

Server address:

User name:

Password:

Description:

Port:

**Advanced Settings**

Specify the concurrent operation limits.

Max concurrent vCenter provisioning operations:

Max concurrent power operations:

Max concurrent View Composer maintenance operations:

Max concurrent View Composer provisioning operations:

**vCenter Server Settings**

Before you add vCenter Server to View, install a valid SSL certificate signed by a trusted CA. In a test environment, you can use the default, self-signed certificate that is installed with vCenter Server, but you must accept the certificate thumbprint.

Provide the vCenter Server FQDN or IP address, user name, and password.

**Concurrent Operations Limits**

Max concurrent vCenter provisioning operations: the maximum number of concurrent VM cloning and deletion operations on this vCenter server (full clones).

Max concurrent power operations: the maximum number of concurrent VM power-on, power-off, reset, and configuration operations (full clones and linked clones).

Max concurrent View Composer maintenance operations: the maximum number of concurrent View

Next > Cancel

3. Enter the vCenter server address and vCenter (not local desktop) user credentials in the appropriate fields.
4. Select **Next** to display the **View Composer Settings** tab.

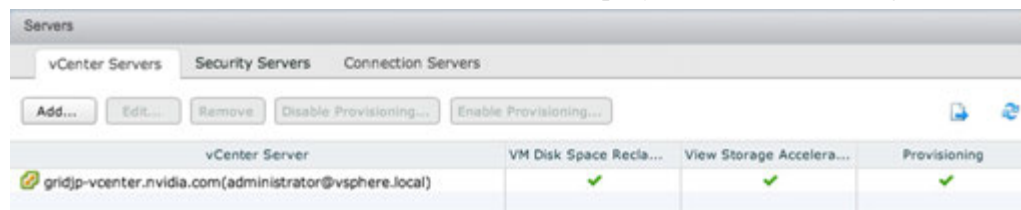
5. Select **Do not use View Composer** and
6. Select **Next** to display the **Storage** tab.



Alternatively, if you wish to use View Composer and have already configured your environment to support Horizon Composer, then select **View Composer** co-installed with vCenter Server and click **Next**. Continue performing the Horizon Composer setup.

7. Accept the default storage settings.
8. Select **Next** to display the **Ready to Complete** window.
9. Click **Finish**.

The vCenter server is now added and will display in the View configuration.



## 6.4 INSTALLING VIEW COMPOSER SERVER

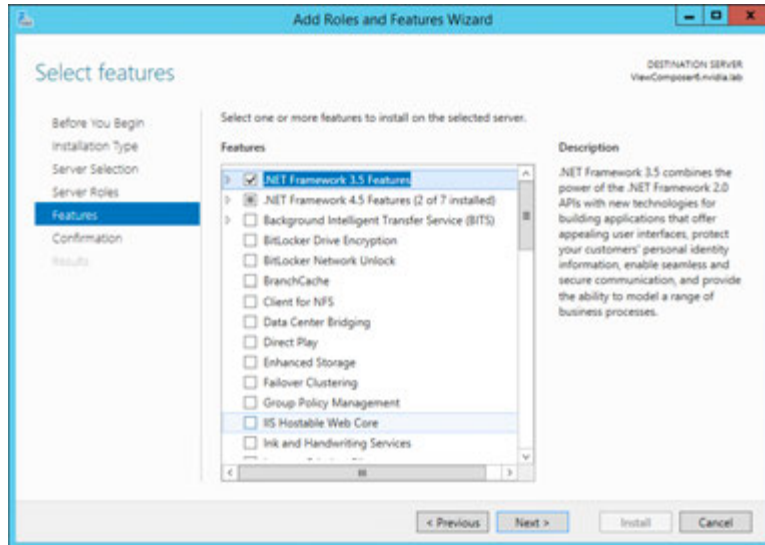
The server on which you are installing View must meet the requirements listed in “General Prerequisites” on page 15. You will also need access to a SQL server. For the purposes of our POC/trial, we installed SQL Express 2008 on a separate Windows Server 2012R2 guest on our management cluster.

The purpose of the Composer Server is to create Linked Clones, the requirements are:

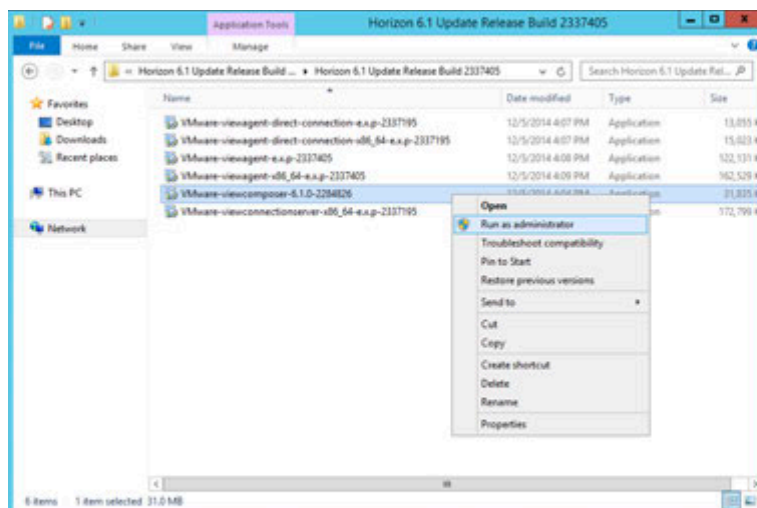
- ▶ 1 Microsoft Windows Server 2012R2 servers for Horizon View Composer
- ▶ 1 Microsoft Windows Server 2012R2 servers for SQL 2008

Use the following procedure to install View Composer 6.1:

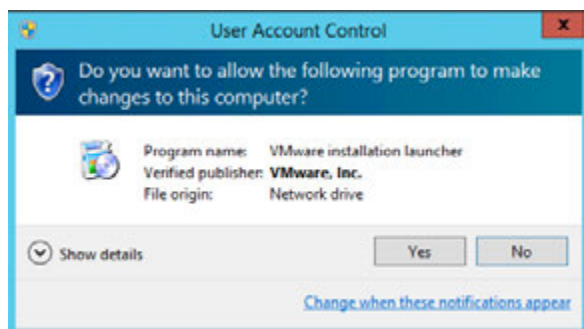
1. On the server guest you are installing Composer, use the **Add Roles and Features Wizard** to add **.NET Framework 3.5 Features**.



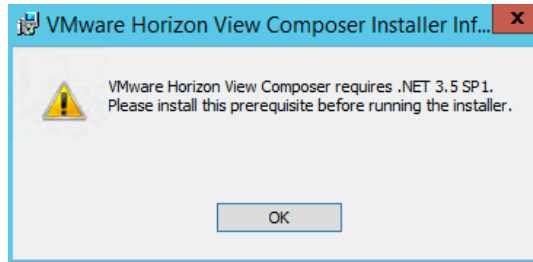
2. Run the View Composer install as Administrator by right clicking on the installation application and selecting run as Administrator.



3. If the UAC security prompt appears, click **Yes**.



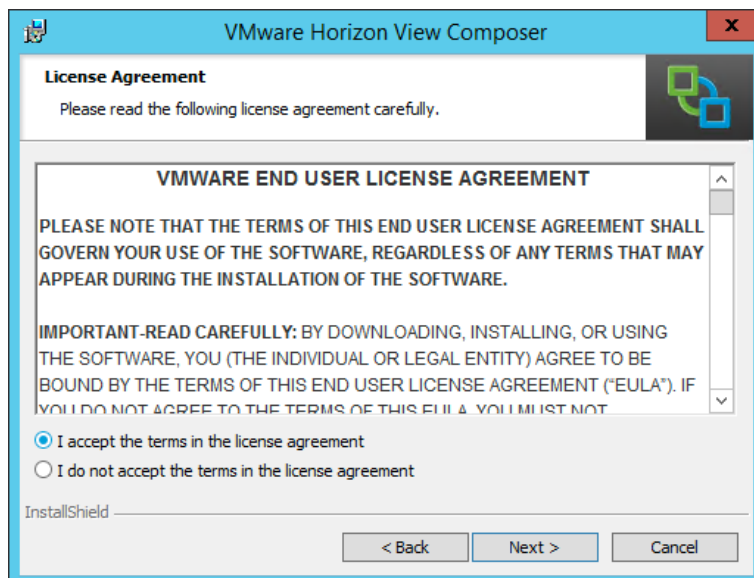
4. If you receive the following error, quit the install and install .NET 3.5.



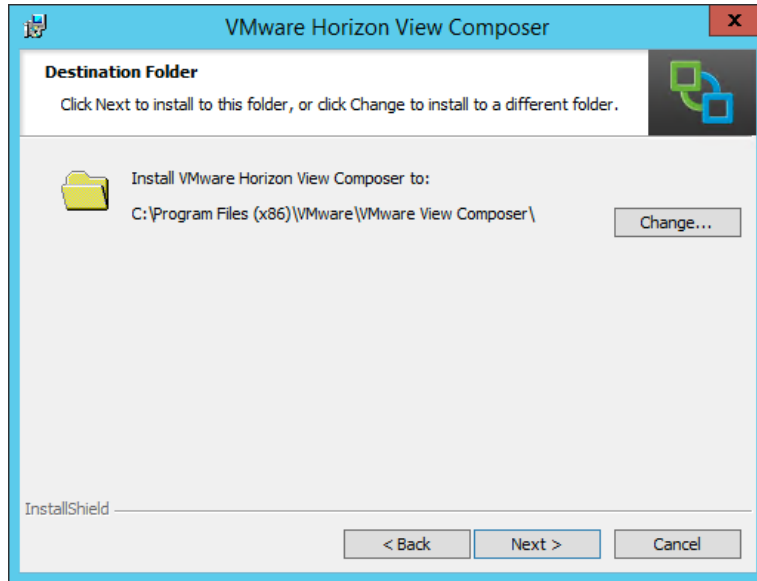
5. The VMware Horizon View Composer installer begins, click **Next**.



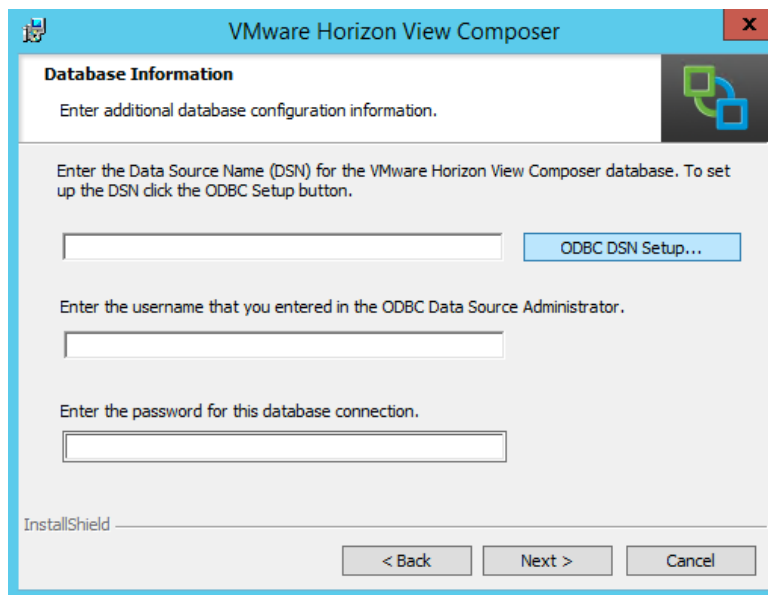
6. Check **I accept the terms of the license agreement** radio button to accept the agreement. Select **Next** to continue.



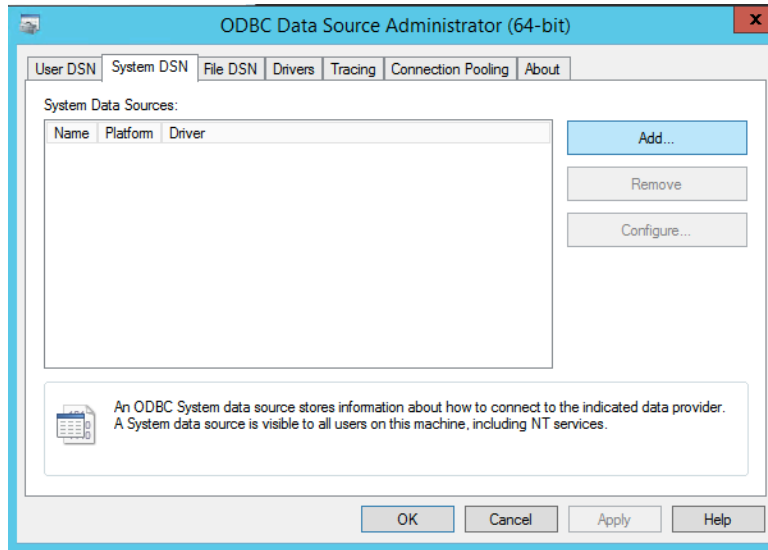
7. The Destination Folder window displays, choose an install location and click **Next**.



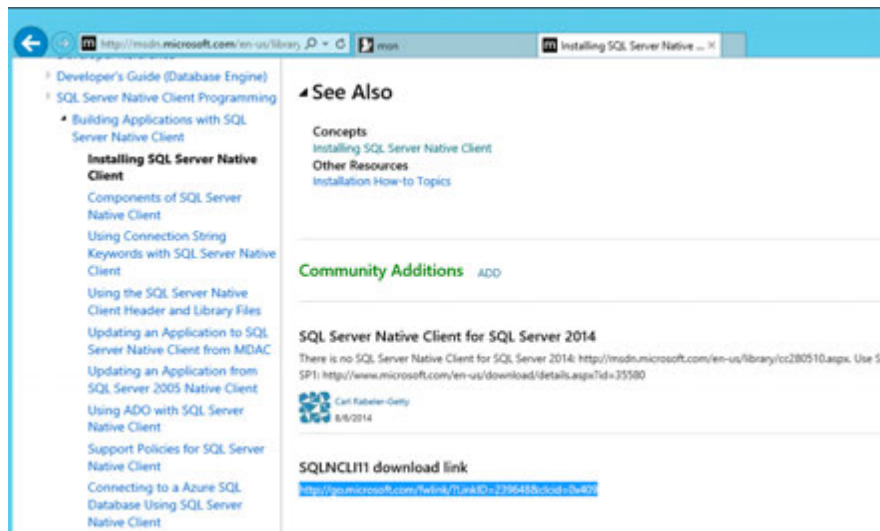
8. Next set up a connection to a SQL server. Click the **ODBC DSN Setup...** button.



9. Click the **Add...** button.

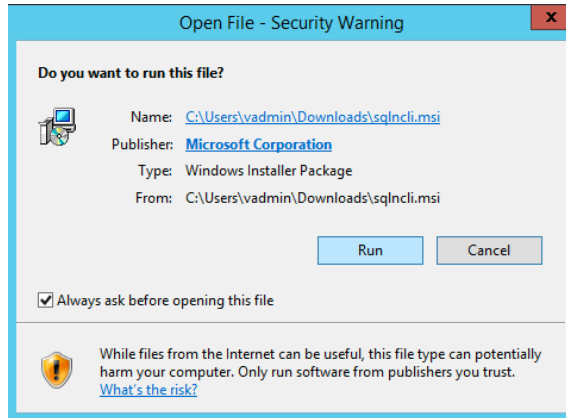


10. You may need to download and install the SQL Server Native Client.

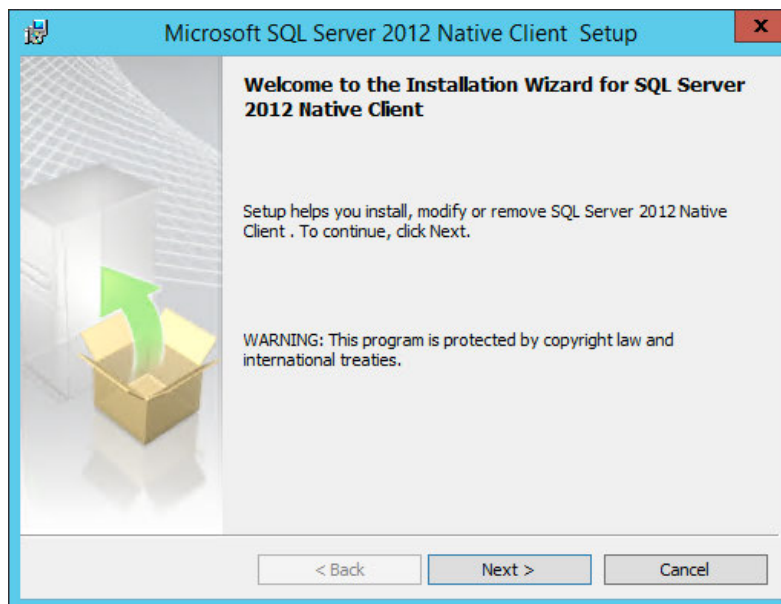


11. Accept any security warnings after you down and begin install.

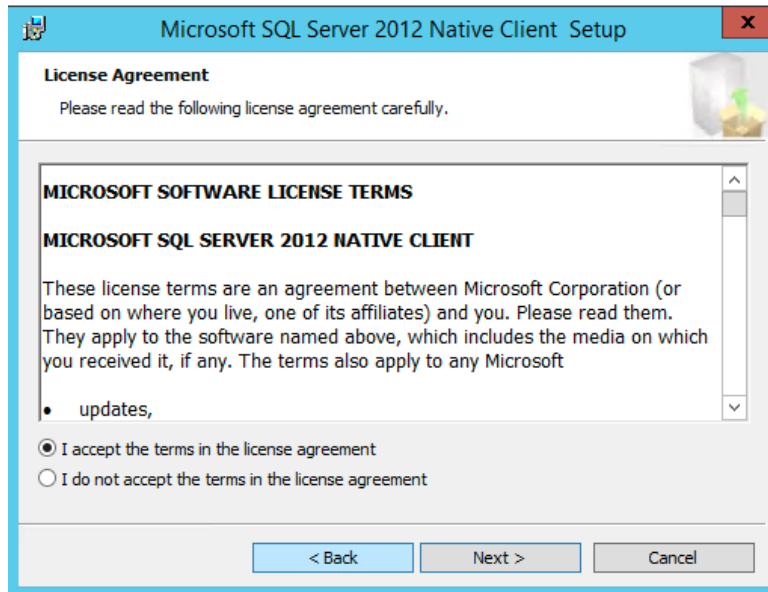




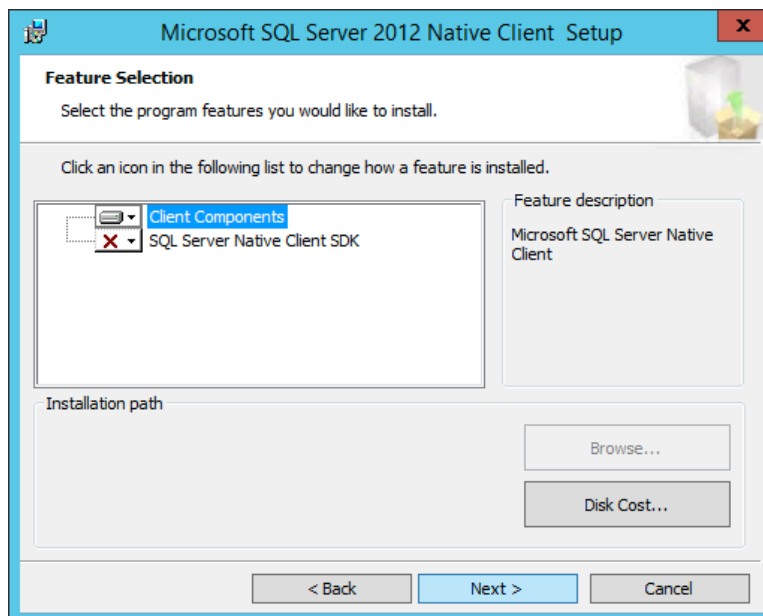
12. Follow all the defaults to install.



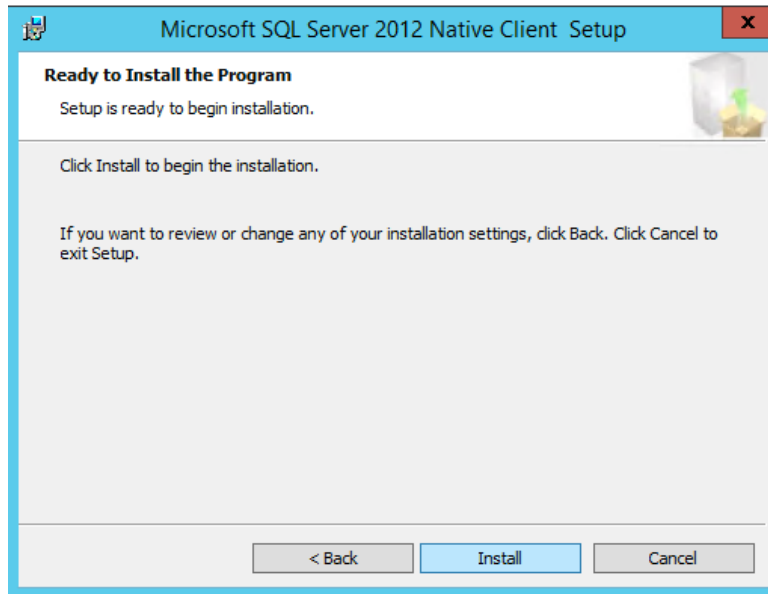
13. Accept the license agreement and click **Next**.



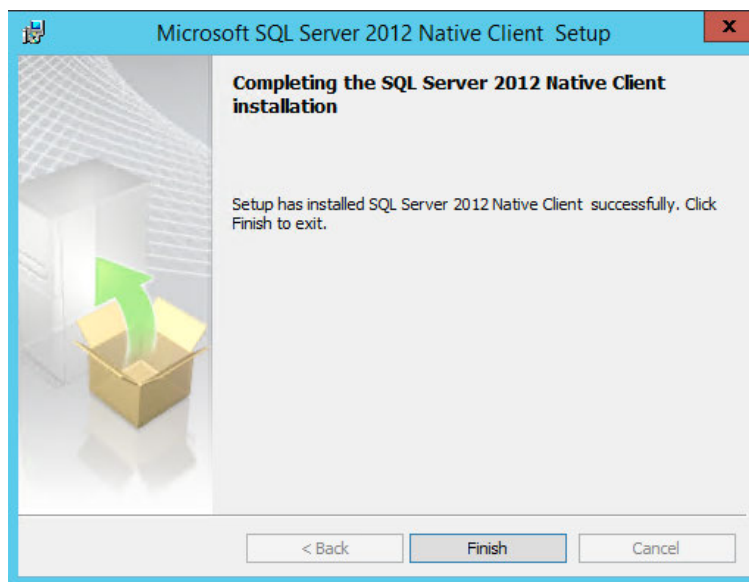
14. Accept defaults and click **Next**:



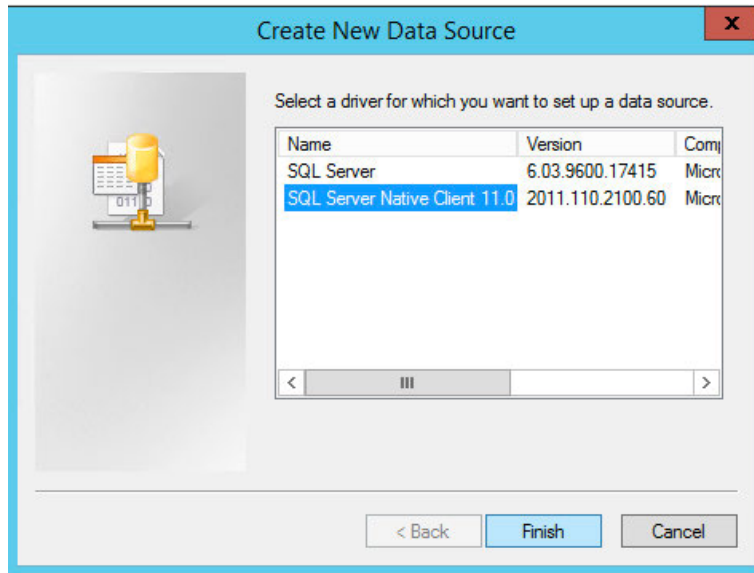
15. Click **Install**:



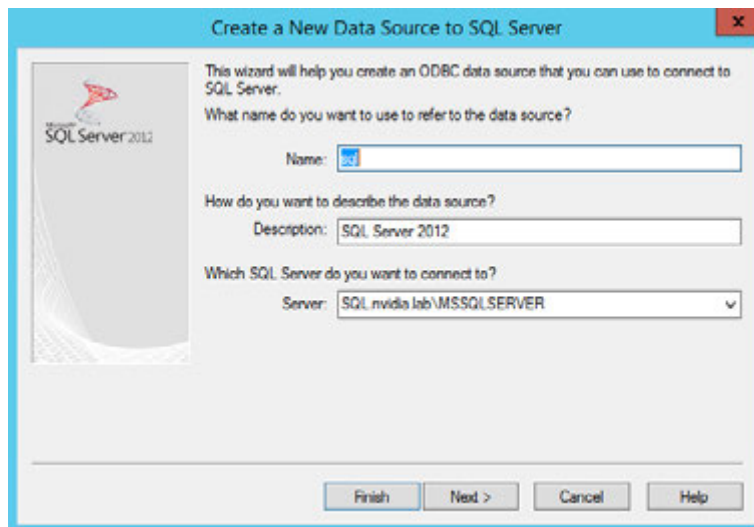
16. Once install is complete, click **Finish**:



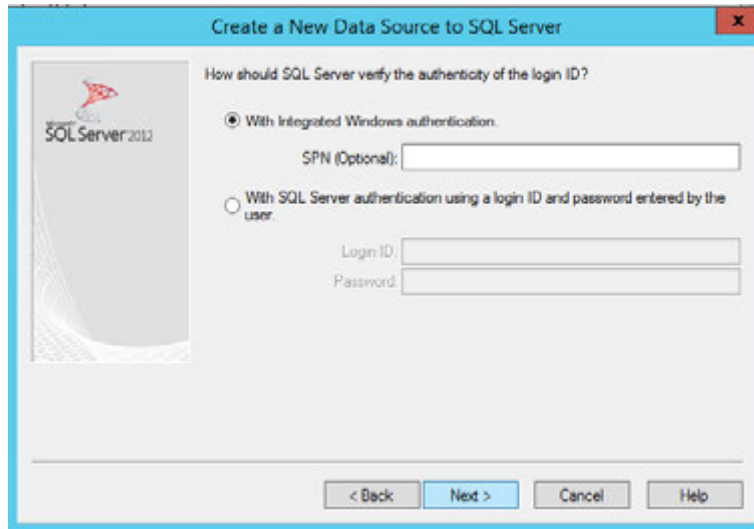
17. Return to (or restart) the **ODBC DSN Setup** for View Composer. Select the SQL Native Client 11 in the **Create New Data Source** wizard and click **Finish**.



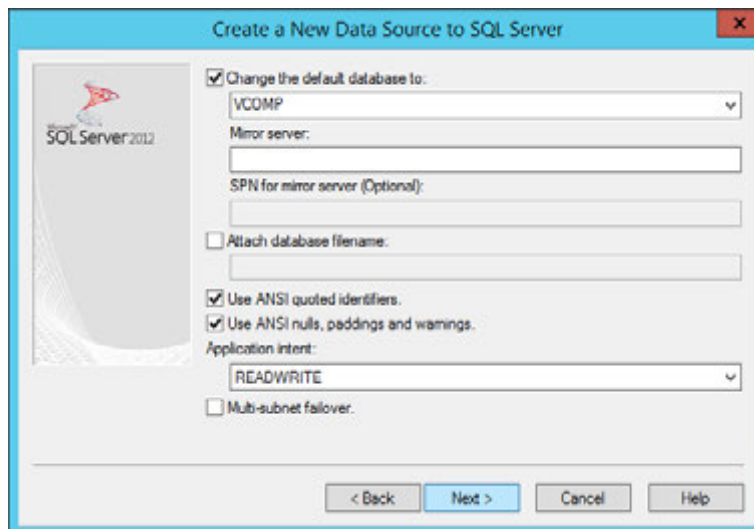
18. Name your New Data Source and locate the correct SQL server you want to connect. Click **Next** to continue



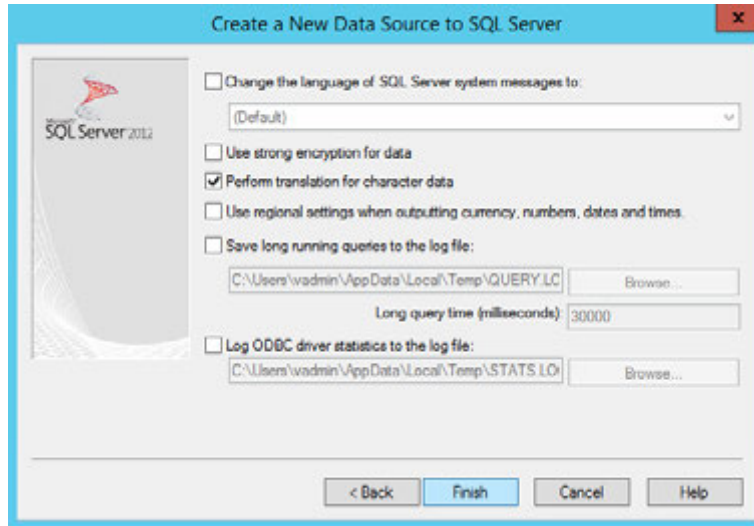
19. Select **With Integrated Windows authentication** (However, you will need to supply an SQL Admin account later in the install.)



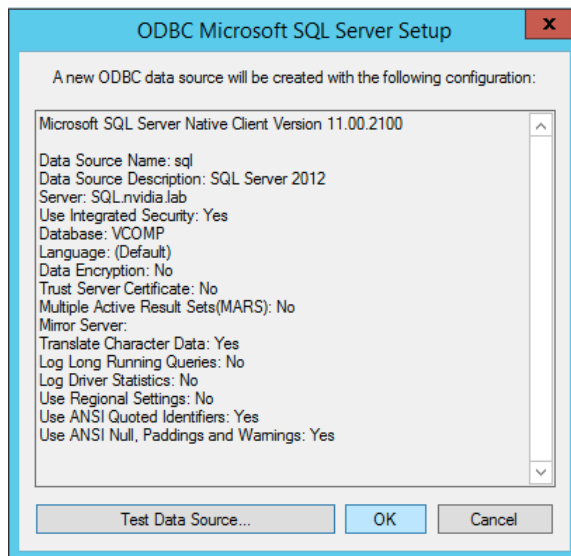
20. Select **Change the default name to:** and name your database for the View Composer. Click **Next** to continue.



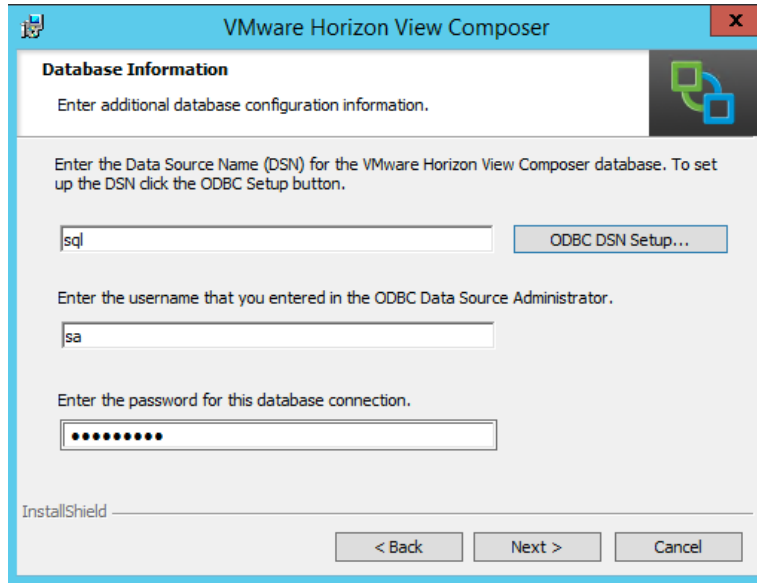
21. Click **Finish** to continue.



22. Review your configuration and click on **Test Data Source...**



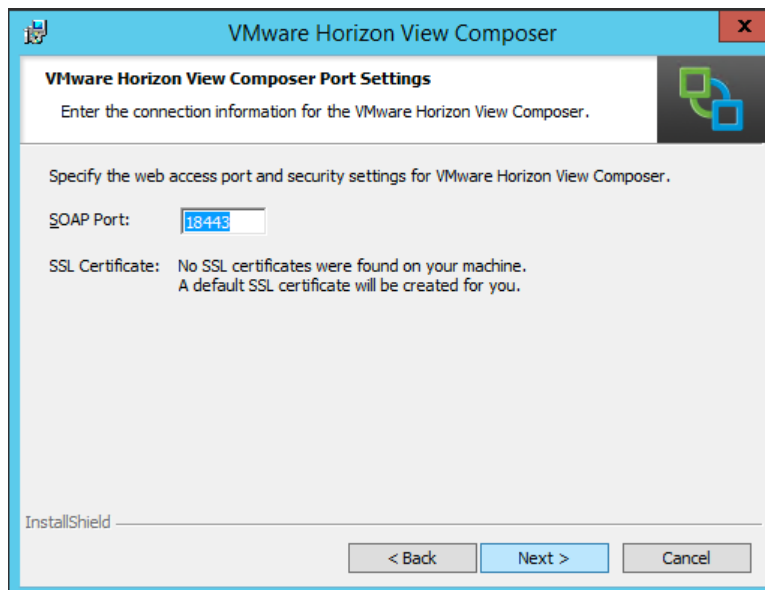
23. If all is good you will get a successful configuration. If not, go back and review your settings.
24. Return to the View Composer installation and enter the database name, SQL Admin account name and Password to complete installation. Select Next to continue.



The screenshot shows the 'Database Information' dialog box in VMware Horizon View Composer. The title bar reads 'VMware Horizon View Composer'. The dialog has a blue header and a light gray body. It contains the following elements:

- Database Information** section with the instruction: 'Enter additional database configuration information.'
- A text box for the Data Source Name (DSN) containing 'sql', with an 'ODBC DSN Setup...' button to its right.
- A text box for the username containing 'sa'.
- A password field (masked with dots) for the database connection.
- An 'InstallShield' logo at the bottom left.
- Navigation buttons at the bottom: '< Back', 'Next >', and 'Cancel'.

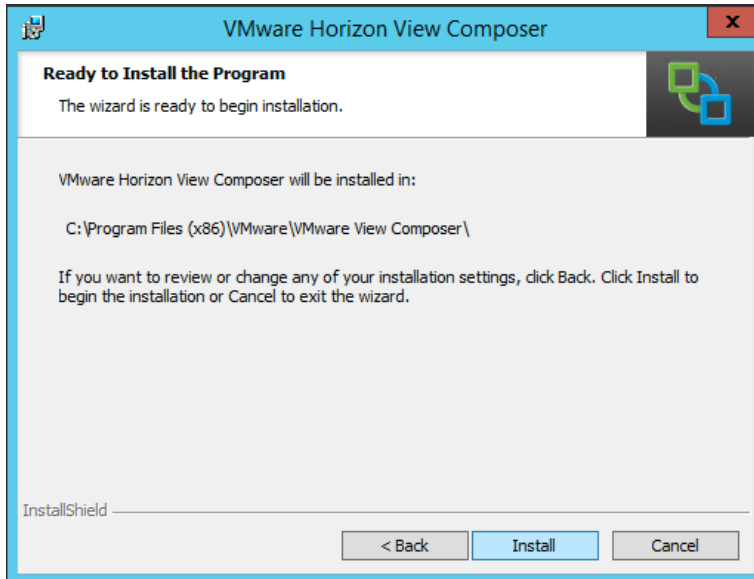
25. Select the web access port number. (Stay with default if possible.) Select Next to continue.



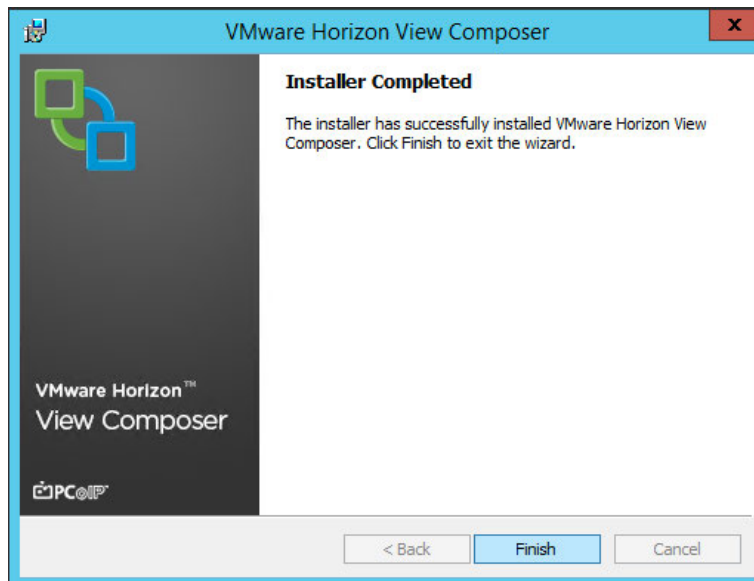
The screenshot shows the 'VMware Horizon View Composer Port Settings' dialog box. The title bar reads 'VMware Horizon View Composer'. The dialog has a blue header and a light gray body. It contains the following elements:

- VMware Horizon View Composer Port Settings** section with the instruction: 'Enter the connection information for the VMware Horizon View Composer.'
- A text box for the SOAP Port containing '18443'.
- An SSL Certificate status message: 'No SSL certificates were found on your machine. A default SSL certificate will be created for you.'
- An 'InstallShield' logo at the bottom left.
- Navigation buttons at the bottom: '< Back', 'Next >', and 'Cancel'.

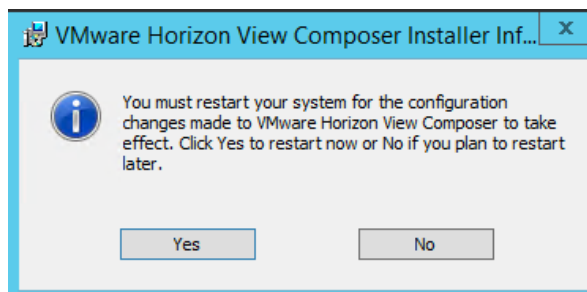
26. Select **Install** to continue.



27. The install completes, click **Finish**:



28. A full system reboot is required. Click **Yes** to complete the install and reboot the server.



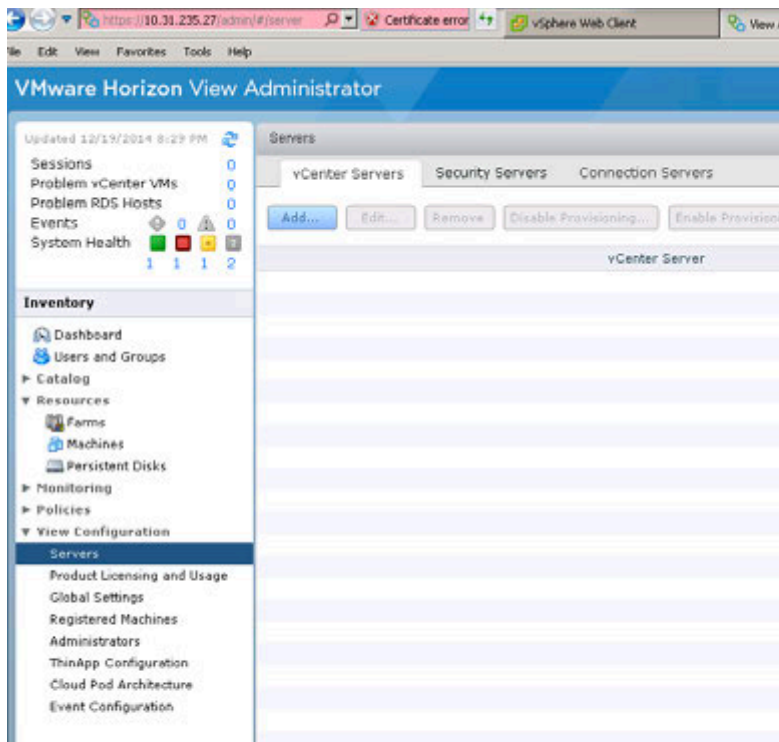


29. Once the server is back up, move on to register Composer to Horizon. (It may take a few minutes for all the services to start up, so be patient.)

## 6.5 REGISTERING VIEW COMPOSER SERVER

1. Login to View Server to register the View Composer Server.

Select **Servers** under the **View Configuration** submenu in the left hand window. Select **Edit** in the center window to add a View Composer to an existing vCenter Server or **Add** to add a new vCenter Server with a View Composer.



2. Enter the vCenter Server address, administrator account and password. Customize the configuration with the advanced settings if needed.

3. View the Invalid Certificate Detected by selecting **View Certificate**.

4. Select **Accept** to continue.

5. In this example, we used a standalone View Composer Server. Enter the server address, user account name and password. (If you co-installed with vCenter Server, select the View Composer co-installed option.)

**Add vCenter Server**

**View Composer**

**View Composer Settings**

☐ Do not use View Composer

☐ View Composer co-installed with vCenter Server

Choose this if View Composer is installed on the same server as vCenter

Port: 18443

☒ Standalone View Composer Server

Choose this if View Composer is installed on a separate server from vCenter

Server address: 10.25.235.26

User name: administrator

Password: \*\*\*\*\*

Port: 18443

**View Composer Settings**

View Composer can be installed on the vCenter Server host or a standalone host.

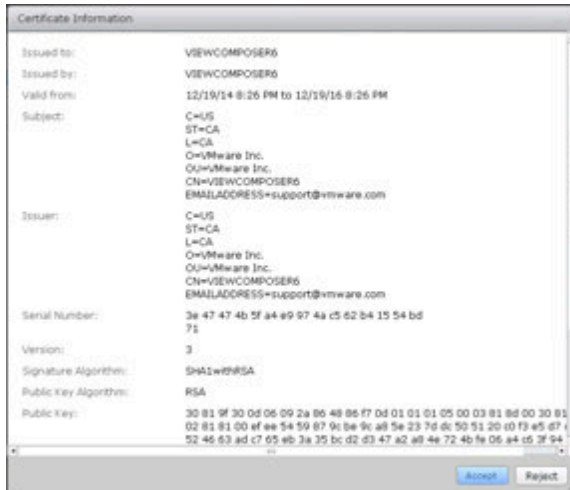
Before you add View Composer to View, install a valid SSL certificate signed by a trusted CA. In a test environment, you can use the default, self-signed certificate that is installed with View Composer, but you must accept the certificate thumbprint.

< Back Next > Cancel

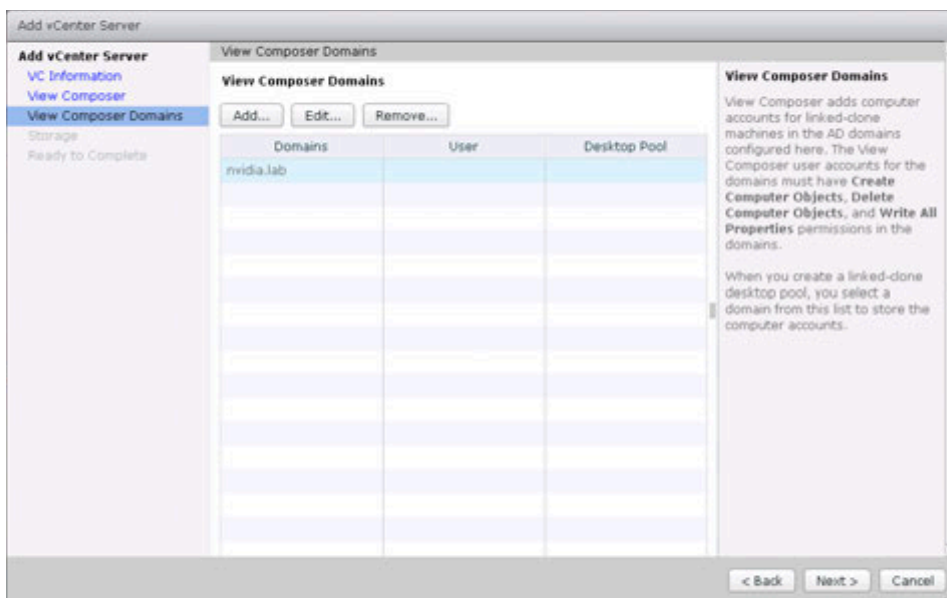
6. View the Invalid Certificate detected by selecting View Certificate.



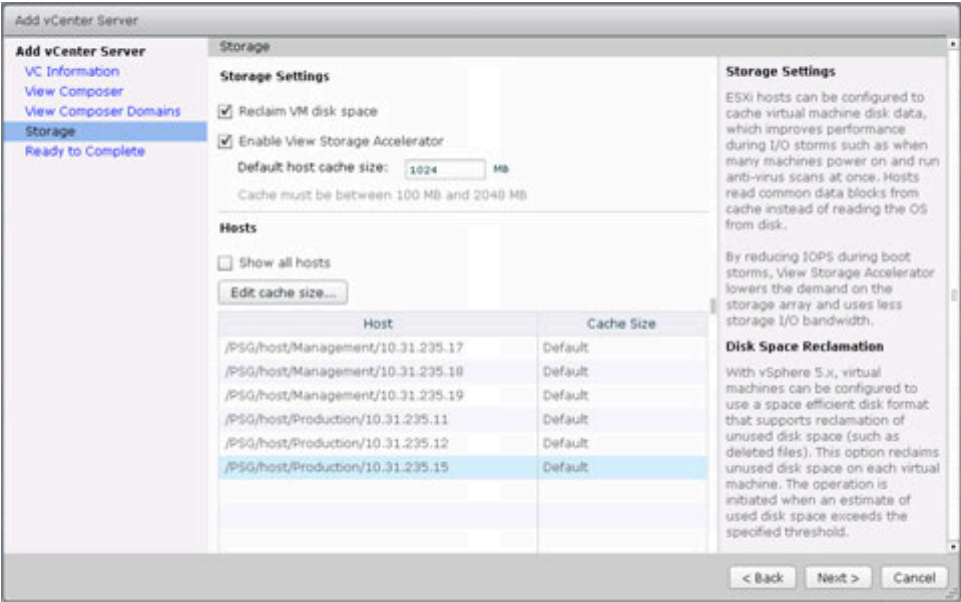
7. Accept the Certificate by selecting Accept.



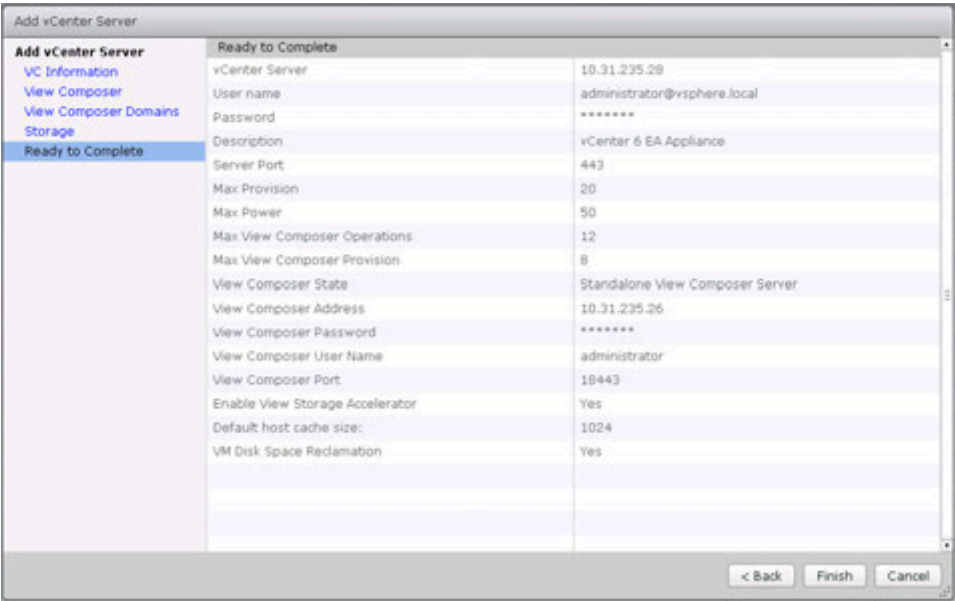
8. Select next to continue after viewing the View Composer Domains created.



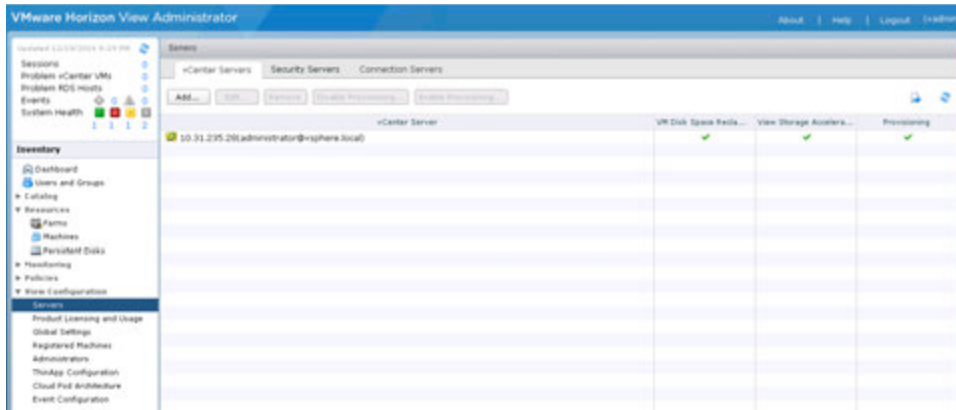
9. Select View Storage Settings. **Check Reclaim VM disk space, Enable View Storage Accelerator** and set the **Default host cache size**. You can customize the Cache Sizes of each ESXi host at this point if needed by selecting **Edit cache size**. When ready click **Next** to continue.



10. Review your configuration and select **Finish**.



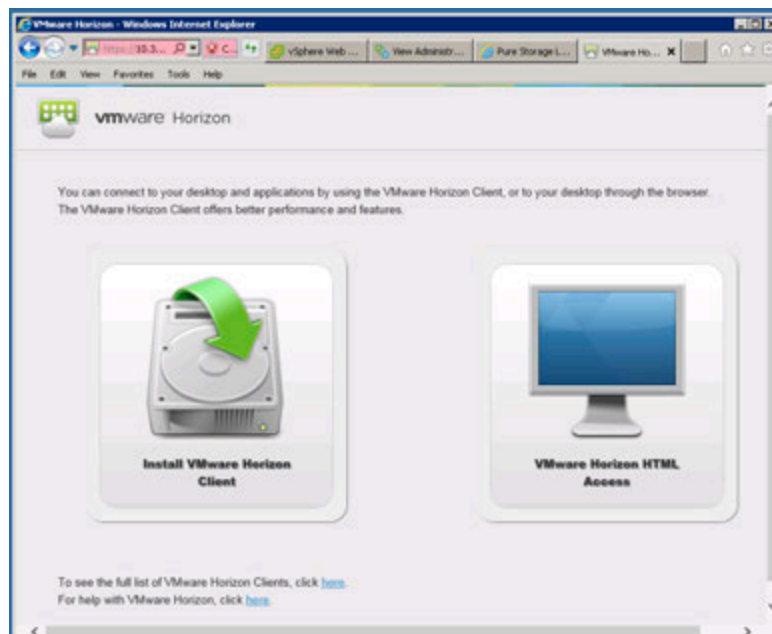
11. Verify your vCenter Server with View Composer is ready to go.



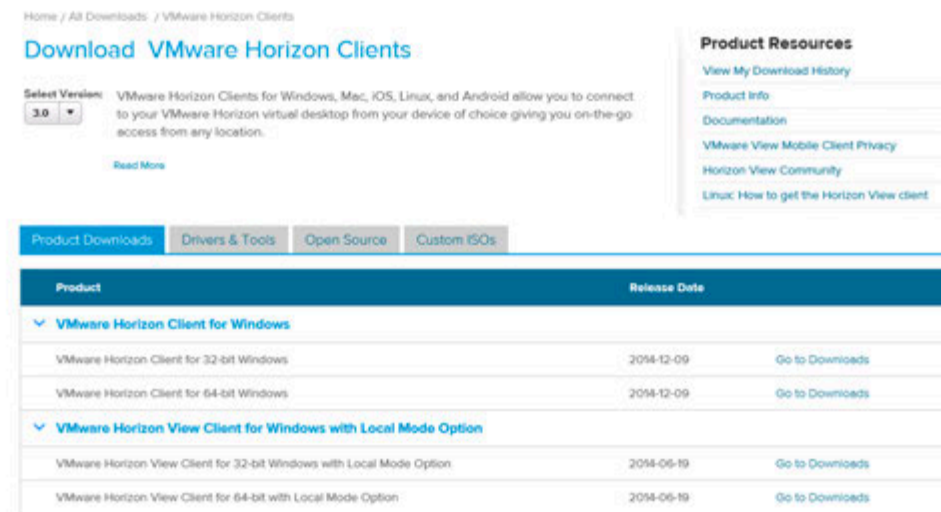
## 6.6 INSTALLING THE HORIZON CLIENT

Before connecting to a virtual desktop over a PCoIP connection, a VMware Horizon Client will need to be installed onto a desktop or device the virtual desktop will be accessed from.

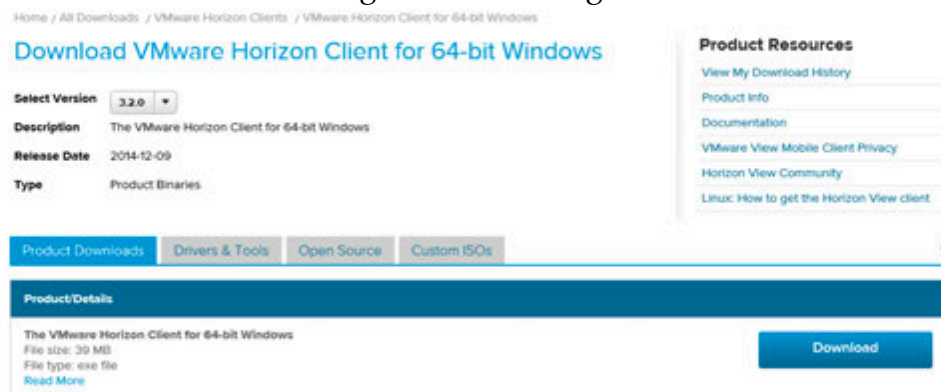
1. While logged into the physical device, open an internet browser. Navigate to the Horizon View Connection Server URL installed earlier in this section. Click on Install VMware Horizon Client.



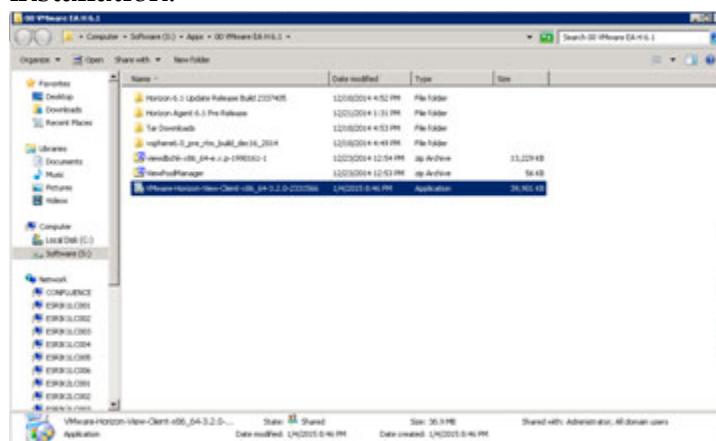
- The **Download VMware Horizon Clients** page will open. Locate the download for the correct OS and click on **Go to Downloads** on the right hand side.



- Click on **Download** to begin downloading.

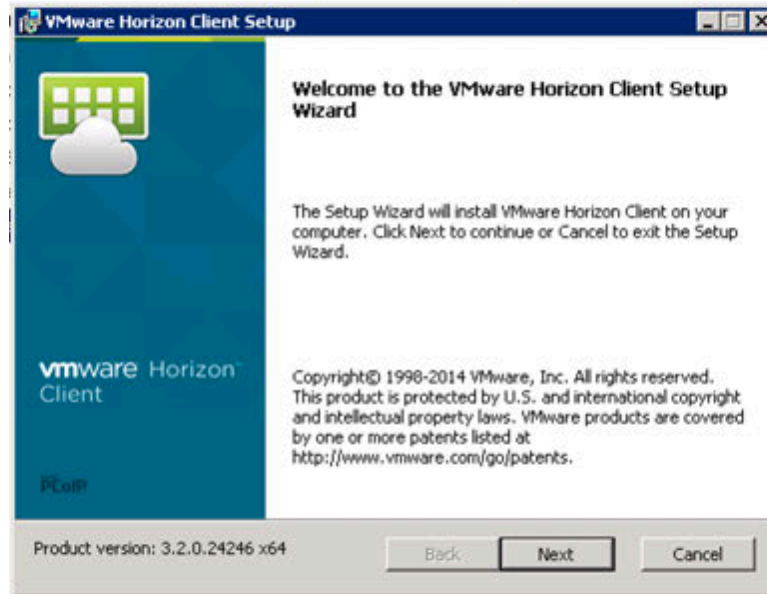


- Locate the downloaded installer program and double click to begin installation.

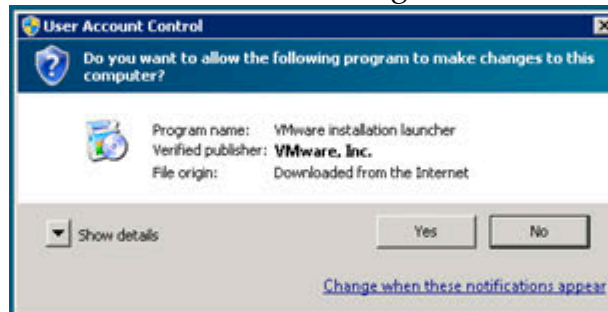


- Click **Next** to continue installation.

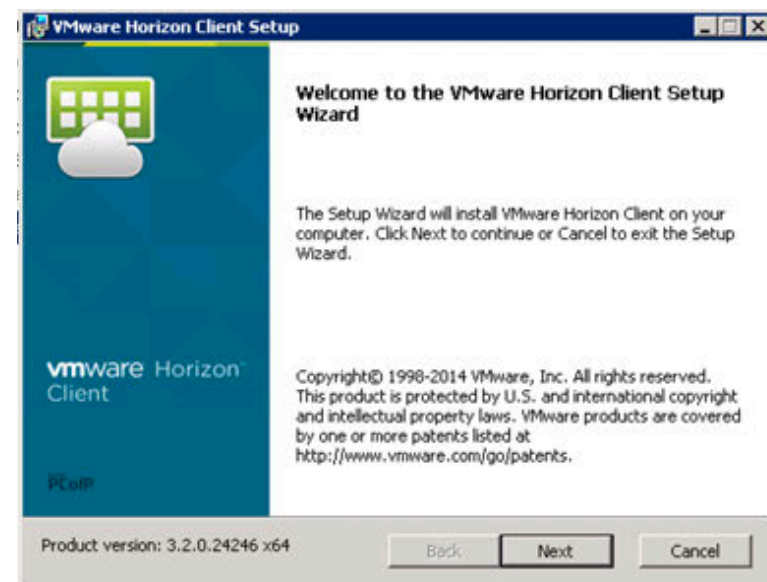




6. Click **Yes** to the UAC dialog.

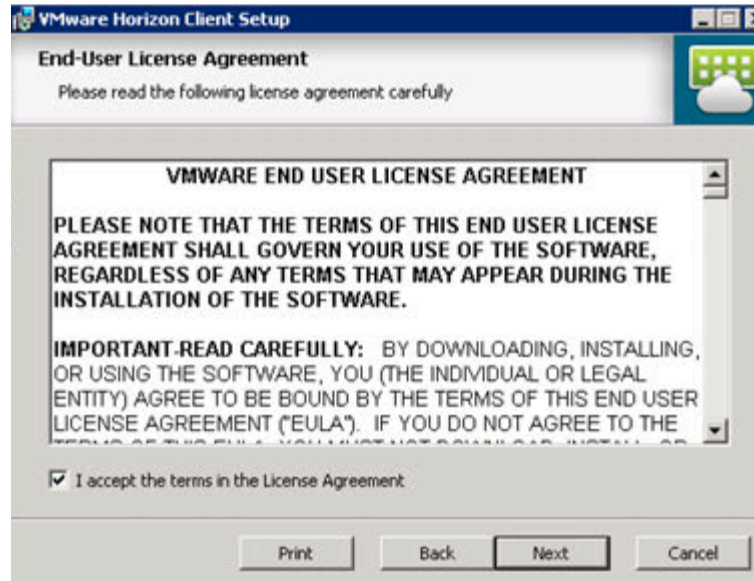


7. Click **Next** to continue.

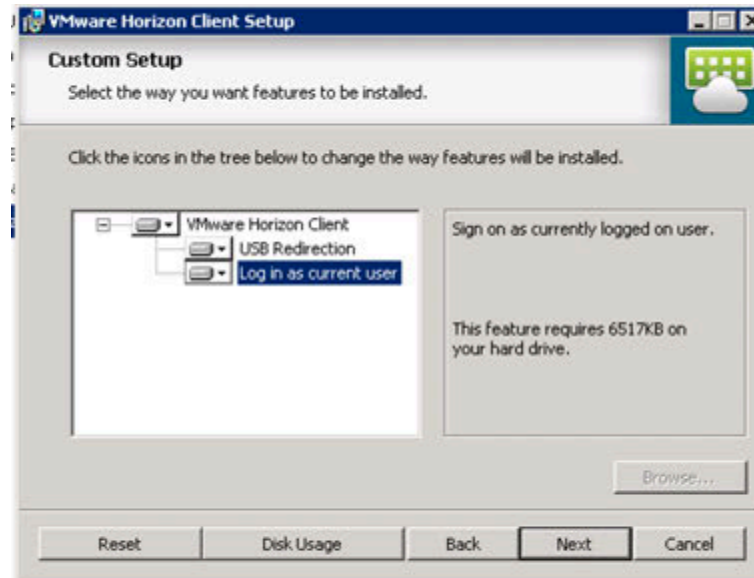


8. Accept the EULA. Click **Next** to continue.

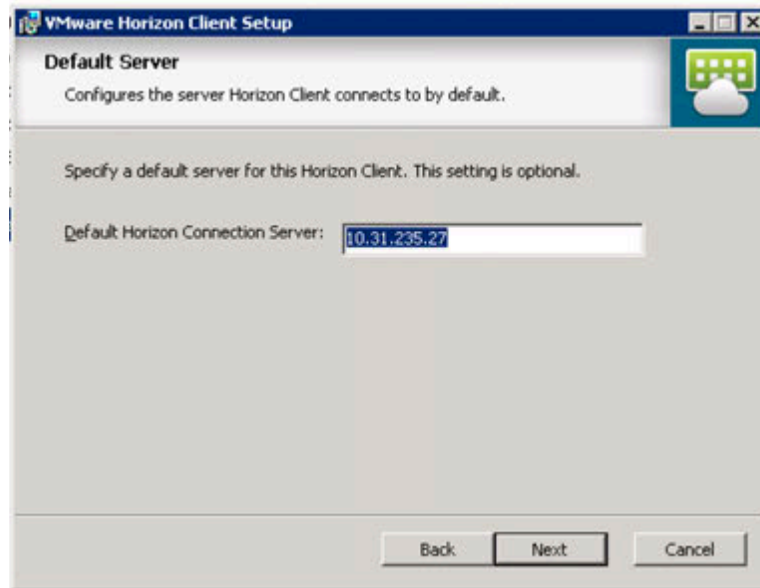




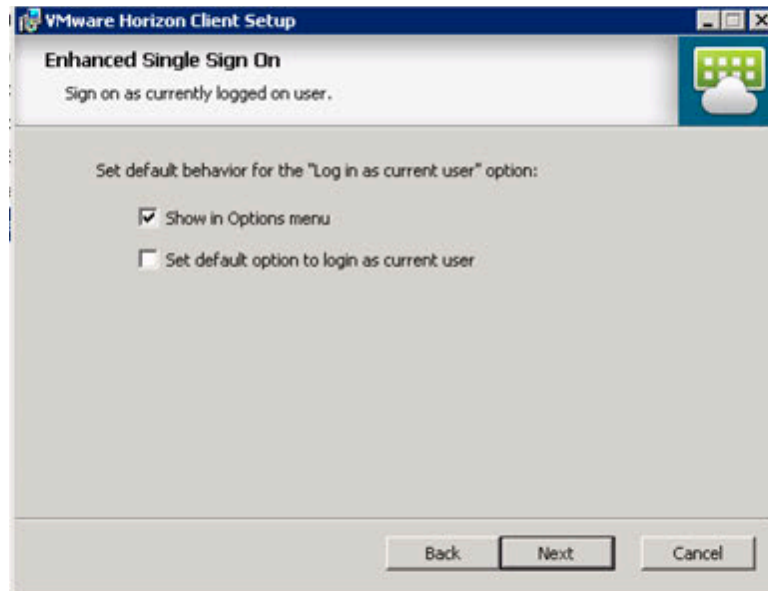
9. Click Next to continue.



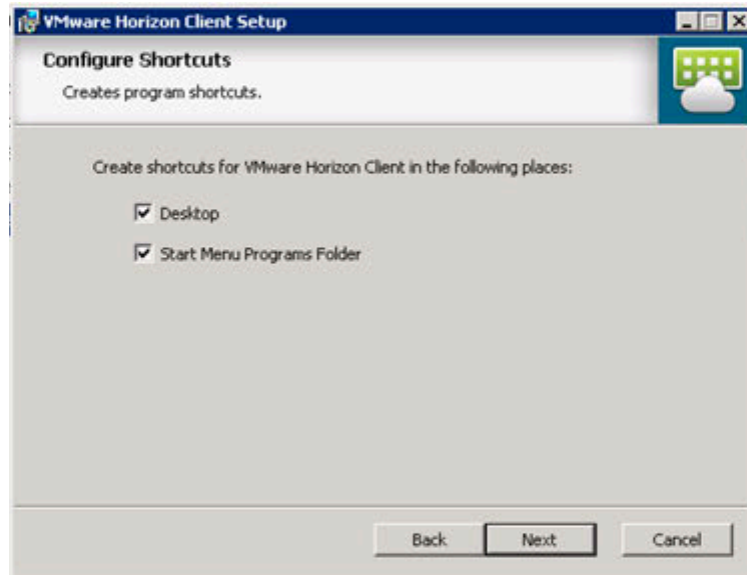
10. Enter IP address of the Horizon View Connection server as default. Click Next to continue.



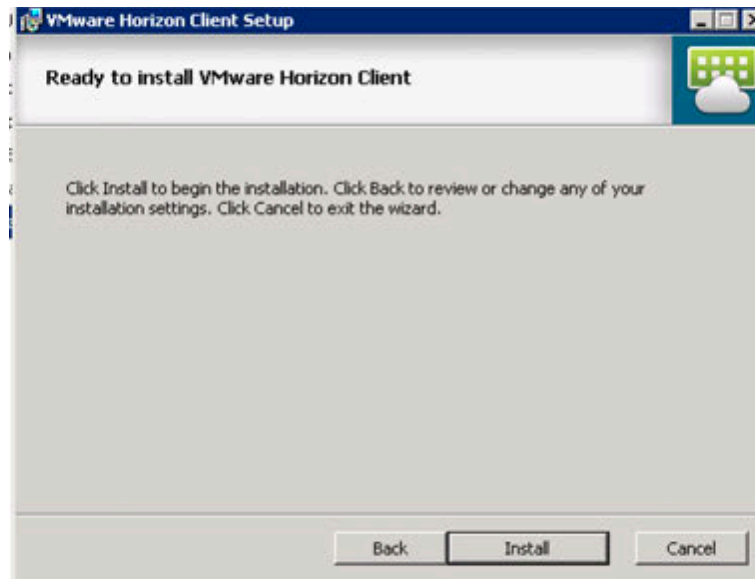
11. Click Next to continue.



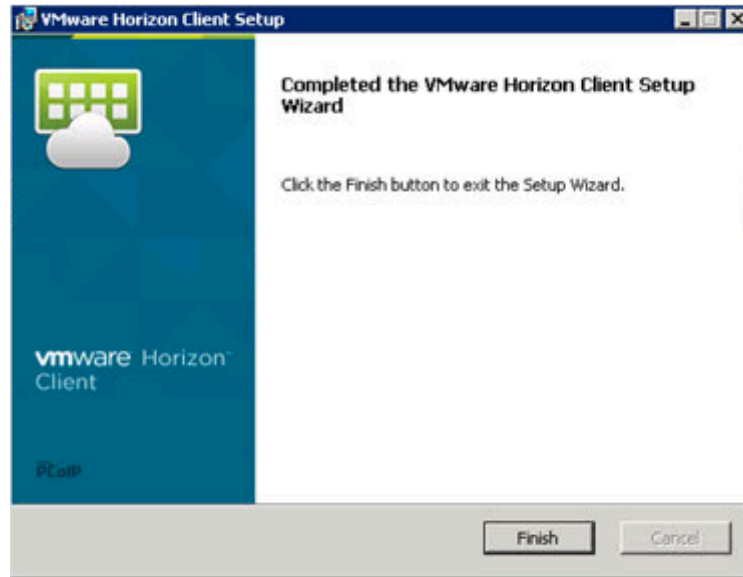
12. Click Next to continue.



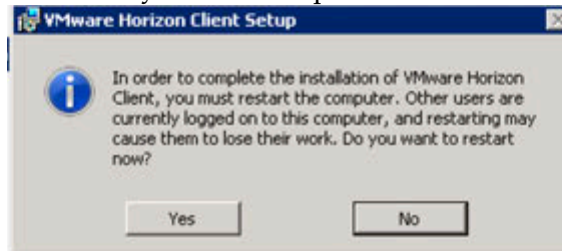
13. Click Next to continue.



14. Click Finish to complete installation.



15. Reboot Physical Desktop.



16. After reboot, log back in to see VMware Horizon Client installed.

# Chapter 7.

## BUILDING A VGPU VSPHERE HOST CLUSTER

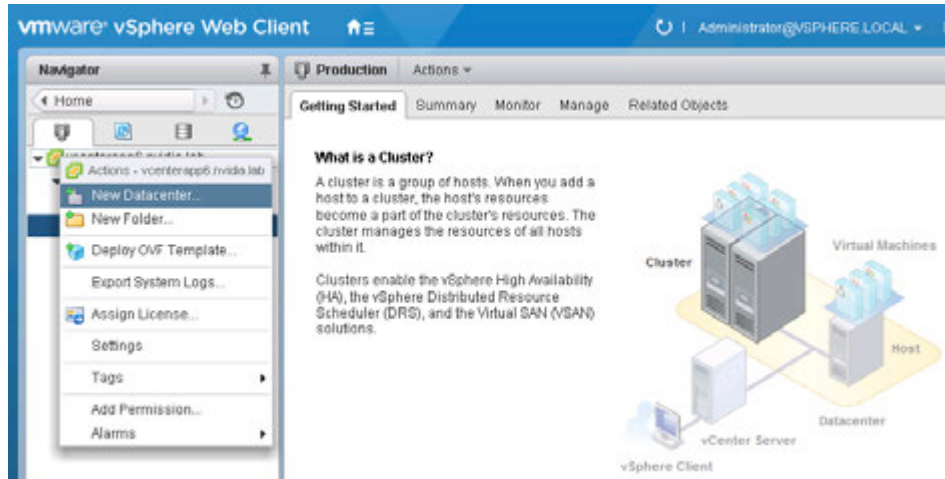
This section covers adding logical organizational units in vCenter to cluster hosts and manage them under a data center object. This is especially important for distributing vGPU-enabled desktops across clustered vSphere hosts with NVIDIA GPUs.

### 7.1 ADDING VSPHERE HOSTS TO MAKE A CLUSTER

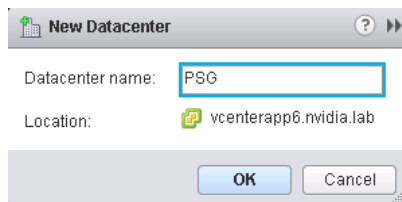
To make a cluster you first create a Datacenter, then a cluster inside that cluster, and finally add hosts to the cluster. Then the hosts can be managed in a group.

#### 7.1.1 Creating a DataCenter in vCenter

1. Log in to vCenter Server's vSphere Web Client and click on **Home**.

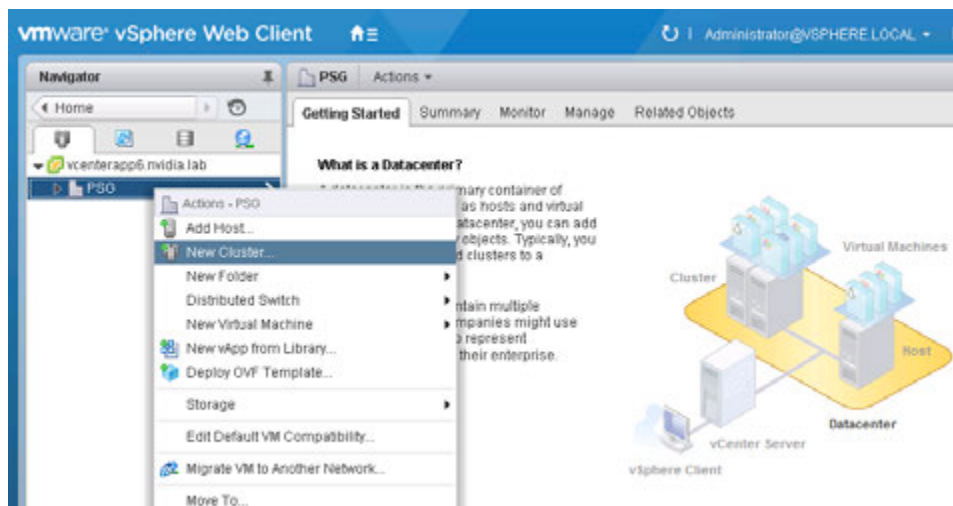


2. On the resulting pop-up, enter a name for the new Datacenter, and click OK:

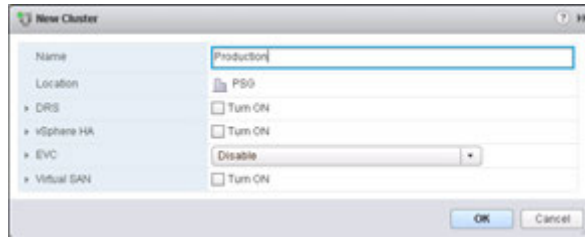


## 7.1.2 Creating a Cluster in the Datacenter

1. Right click on the Datacenter object, then on the menu that pops up click New Cluster...



2. A pop-up appears, enter the name of the new Cluster and click OK:



3. You should now have a logical organizational structure of at least a cluster in a datacenter. In our lab we used two clusters in a datacenter, one for management, the other for production VDI.

## 7.2 ADDING VGPU HOSTS TO A CLUSTER

To create a VGPU Cluster, just add VGPU enabled hosts to your virtual desktop cluster. This cluster must only contain hosts that have NVIDIA GPUs that support NVIDIA GRID VGPU. This is required in order to support better distribution of resources for VGPU.

Horizon will automatically load balance vGPU enabled virtual desktops across a host with the appropriate GPUs, even multiple pools using different profiles built with View Composer have this capability. As an example, if you create two linked clone pools, one with K120Q profile and one with K220Q, View will put the former on hosts with K1 cards, the latter on K2, with no additional management to do so. A huge benefit when you begin to add more and varied user groups.

# Chapter 8.

## SELECTING VGPU PROFILES

This chapter covers VGPU profiles and considers in choosing them for your needs including:

- ▶ List of available VGPU profiles
- ▶ Matching profiles to user needs

### 8.1 THE ROLE OF THE VGPU MANAGER

vGPU profiles assign custom amounts of dedicated graphics memory. NVIDIA GPU Manager assigns the correct amount of memory to meet the specific needs of each user. Every virtual machine has dedicated graphics memory (just like any desktop or laptop device), thus ensuring that it has the resources needed to handle the expected graphics load.

NVIDIA vGPU Manager allows up to eight users to share each physical GPU by assigning the graphics resources of the available GPUs to virtual machines using a balanced approach. Each NVIDIA GRID K1 card has four GPUs, allowing up to 32 users to share a single card, a GRID K2 has two GPUs allowing up to 16 users per card.

### 8.2 THE FULL LIST OF VGPU PROFILES

The profiles represent a line up of virtual GPUs, varying in size of frame buffer memory and number of heads. The division of frame buffer is what defines the number of users



possible per GPU with that specific profile, while the number of heads defines the number of displays supported. Max resolution is consistent across all the profiles.

**Table 8-1. NVIDIA GRID vGPU Graphics Memory Options**

NVIDIA GRID Board	Virtual GPU Profile	Application Certifications	Graphics Memory	Max Display per User	Max Resolution per Display	Max Users per Board	Use Case
GRID K2	K280Q	YES	4,096 MB	4	2560x1600	2	Designer
	K260Q	YES	2,048 MB	4	2560x1600	4	Designer/Power User
	K240Q	YES	1,024 MB	2	2560x1600	8	Designer/Power User
	K220Q	YES	512 MB	2	2560x1600	16	Power User
GRID K1	K180Q	YES	4,096 MB	4	2560x1600	4	Power User
	K160Q	YES	2,048 MB	4	2560x1600	8	Power User
	K140Q	YES	1,024 MB	2	2560x1600	16	Knowledge Worker
	K120Q	YES	512 MB	2	2560x1600	32	Knowledge Worker

## 8.3 WHY THE “Q” ON THE PROFILE?

Like the NVIDIA Quadro cards for professional graphics applications, the vGPU profiles ending in **Q** undergo the same rigorous application certification process as those -class processors. As a result, you can expect 100% compatibility and performance with your applications, and ISVs requiring Quadro can certify against the GRID vGPU profiles as well. For a list of certified applications, visit [www.nvidia.com/gridcertifications](http://www.nvidia.com/gridcertifications).

## 8.4 MATCHING PROFILES TO USER NEEDS

As stated earlier in the deployment guide, you need to define your user needs and match them to available NVIDIA GRID vGPU graphics card profiles.

If we take the three example Revit user use cases and their computing needs defined earlier, we can now match the video RAM and display needs to desired GRID vGPU profiles. See below:

- Entry Level Engineer / Design Reviewer
  - 4 GB RAM
  - 2 VCPUs (2.5 GHz)
  - 1 GB video RAM – K240Q or K140Q
  - 2 2560x1600 displays

- ▶ Mid Level Engineer
  - 8 GB RAM
  - 2-4 VCPUs (2.5 GHz)
  - 2 GB video RAM – K260Q or K160Q
  - 4 2560x1600 displays
- ▶ Advanced Engineer
  - 16 GB RAM
  - 4-8 VCPUs (2.5 GHz)
  - 4 GB video RAM – K280Q
  - 4 2560x1600 displays

## 8.5 POWER USER & DESIGNER PROFILES

Prior to NVIDIA GRID and Horizon it was impossible to move your most demanding end users into the data center. They were essentially denied mobility, ease of management, data centrality and security, disaster recovery protection, and the rest of the benefits of virtualization. These users were chained to their workstation, which was chained to a desk. vDGA pass through and other solutions were developed that allowed remote workstation access, but with a 1:1 ratio the costs were high and no resource pooling efficiency was gained. Now multiple workstation users can be placed on a single host, even combined with other less demanding users to increase density. Suddenly there were choices when designing a solution.

The key to picking a profile for these users is compatibility and performance. Leveraging the NVIDIA platform, built of proven software and hardware, means you can expect the same high quality experience you, and your key design application, expect from certifying with and using NVIDIA Quadro.

If your users leverage physical GPUs in the range of a K600, then adding K1 cards and then adjusting profiles based on frame buffer requirements allows you the flexibility and density to meet the performance needs of these user groups. If your application demands the highest performance then the K2 with its K5000 equivalent GPU allows you to adjust frame buffer without sacrificing that performance.

Start your profile selection by looking to your primary application's requirements. The software vendors work hard certifying their application will perform well if the right hardware and software is used. Using those requirements, select the appropriate Quadro certified vGPU profile to meet your end user's needs. To understand more about the graphics requirements of your applications, consult your application vendor.

## 8.6 KNOWLEDGE WORKER PROFILES

No user wants a flat, boring experience from their apps and desktop. Application developers know this and continue to increase the rich visual experience when interacting with their applications. While obvious with 3D applications for design or drawing, even the apps used across the vast majority of end users now leverage graphics to one degree or another. These include the underlying operating system's desktop, such as Windows 7 with Aero enabled, and Windows 8.1 takes that to a higher level. Users expect rich web content such as Adobe Flash or HTML 5, better video playback, or the full interactive experience of Microsoft Office (PowerPoint, Excel, Word) with embedded graphics, charts, animation in presentations, etc. The latter, and specifically Microsoft Office 2013, has a check box to enable its ability to leverage graphics hardware (GPU) acceleration.

The Knowledge Worker application workload is filled with subtle graphics we take for granted and miss when not present. Adobe PDF adds shading effects to the text in a document, giving it a rich, high quality appearance. When you scroll a document you expect the text to smoothly move up or down so you can easily scan the content. The same goes for web pages. Take these effects away from an end user and their adoption of your solution is impacted.

## 8.7 K280Q & K180Q PROFILES VS VDGA

With the addition of these two profiles, each assigned the full 4GB of Frame Buffer memory assigned to a GPU, you no longer have to pull valuable GPUs out and manage them separately as assigned with vDGA. Now you can manage all your user groups, from high density Knowledge Workers needing the rich and responsive experience of 512MB of frame buffer and access to a shared K600 equivalent GPU (K120Q), to the most demanding of workstation end users needing 4GB of frame buffer and access to a full K5000 equivalent GPU (K280Q). When needs change, just shut down your virtual desktop and assign a new profile, which is far more simple than having to shut down a physical machine, change the PCI card, reboot a physical machine.

## 8.8 LEGACY PROFILES

The GRID K100 and K200 GPU profiles were originally designed for the lighter graphics workloads associated with the applications that knowledge workers and power users use most of their time. They were based on what was typically seen for GPU and frame buffer at the time. As the graphics needs of even basic apps continues to increase, plus

the benefit of a Quadro certified driver, the K120Q and K220Q profiles have replaced the 100 and 200 profiles.

# Chapter 9.

## APPLICATION BASED VDI HOST SIZING

### EXAMPLE - ESRI ARCGIS

## 9.1 HOW MANY USERS CAN I GET ON A HOST?

Using one application, ESRI ArcGIS Pro, a typical dialogue with a customer often sounds like this...

*Customer: How many users can I get on a host?*

**NVIDIA: What is their primary application?**

*Customer: ESRI ArcGIS Pro.*

**NVIDIA: Are they primarily 3D or 2D data users?**

*Customer: 3D mostly.*

**NVIDIA: Would you describe them as light, medium, or heavy users?**

*Customer: Medium to heavy.*

**NVIDIA: Power users to designers then.**

*Customer: I need performance AND scalability numbers that I can use to justify the project...*

## 9.2 AN EXAMPLE APPLICATION: ESRI ARCGIS PRO

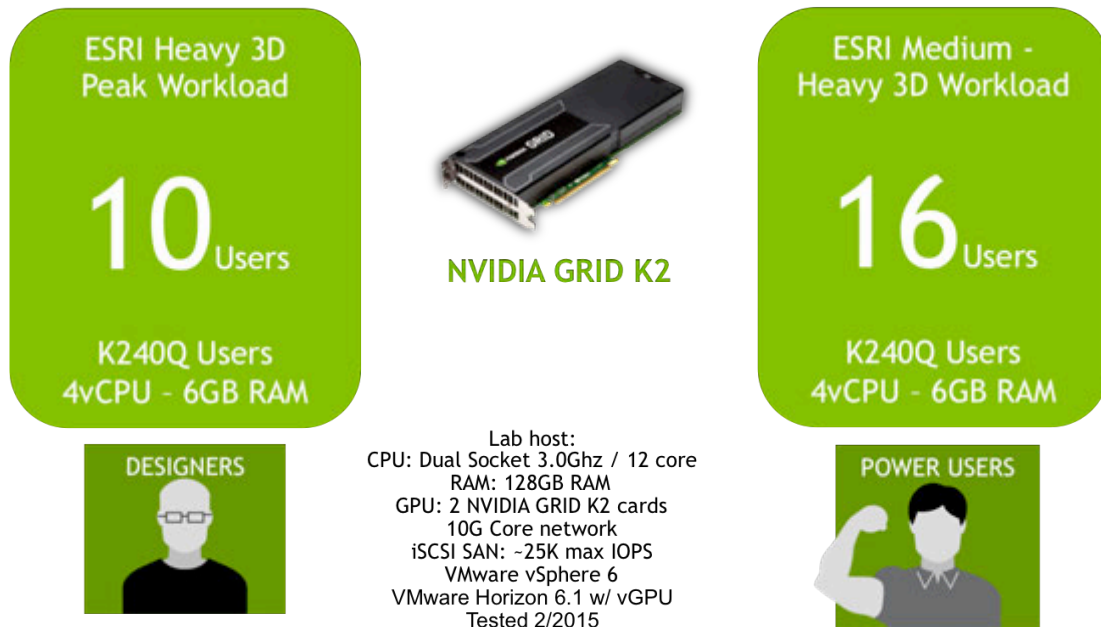
ArcGIS Pro is a premier application for GIS mapping visualizing, editing, and analysis. It requires a GPU, and creates heavy CPU load that needs to be considered in architecting your vGPU solution. The size of your map data, the concurrency of your users, and the level of interaction with 3D data need to be factored into defining your user groups. ESRI classifies its users as follows:

User Classification Matrix						
NVIDIA User Classifications	Knowledge Workers		Power User		Designer	
ESRI User Classifications	Light 2D	Medium 2D	Heavy 2D	Light 3D	Medium 3D	Heavy 3D

Given they are the most graphics intensive users, we focused our tests on the designer and power user groups. Based on our findings, NVIDIA GRID provides the following performance and scalability:

### ESRI ArcGIS Pro 3D

#### Users per Host Server



## 9.3 APPLICATION BASED SIZING

This section contains an overview of the testing, the methodology, and the results that support the findings in this deployment guide. We also detail the lab environment used to test the contents of this guide.

First we look at the specifications of a physical workstation build based on the recommendations of the ISV.

## 9.4 TYPICAL PHYSICAL WORKSTATION

The ISV's website traditionally details a recommended hardware specification, and while a physical workstation is a dedicated solution very different from the shared, flexible solution of VDI, it provides a good starting point to architect your virtual desktops.

### 9.4.1 Recommended system requirements

From ESRI's ArcGIS product page:

CPU speed	Minimum: Hyperthreaded dual core* Recommended: Quad core* Optimal: 2x hyperthreaded hexa core*
Platform	x64 with SSE2 extensions
Memory/RAM	Minimum: 4 GB Recommended: 8 GB Optimal: 16 GB
Display properties	24-bit color depth
Screen resolution	1024x768 recommended or higher at normal size (96 dpi)
Visualization cache	The temporary visualization cache for ArcGIS Pro can consume up to 32 GB of space, if available, in your user profile location.**
Disk space	Minimum: 4 GB Recommended: 6 GB or higher

For the test we key on recommended specifications when feasible. The goal is to test both performance and scalability, to maintain the flexibility and manageability advantages of virtualization without sacrificing the performance end users expect from NVIDIA powered graphics.

## 9.5 UX - THE VDI USER EXPERIENCE

To define user experience (UX) requires defining elements of application and user interaction. This can be obvious like the rendering time for an image to appear, or to smoothly pan across that image, or more subtle like the ability to smoothly scroll down a page, or the “snappy” reaction for a menu to appear after a right click. While elements such as these can be measured, the user’s perception is much harder to measure.

Users also add variables like “think time”, the time they spend looking at their display before interacting again with the application. This time offers an advantage to the underlying resources, such as CPU, as it allows tasks to finish, processes to complete, and is even more beneficial in a shared resource environment such as VDI where one user “thinking” frees up resources for another user who chose that moment to interact with their application. Now factor in other “time” away from the application (meetings, lunch, etc.) and one could expect to get more such benefit to shared resources. The benefit equates to more resources for the user’s session, typically a more responsive application, and thus a better-perceived experience by the end user.

### 9.5.1 ESRI Benchmark Metrics

ESRI provides an API that when loaded allows the gathering of user experience (UX) metrics during benchmarking. ESRI, as the ISV, knows their product best and defines great user experience as the combination of the following metrics:

- ▶ Draw Time Sum: Consists of the sum of time taken for all of the benchmarks to fully draw, this was defined by ESRI to be acceptable up to 45 seconds, less time would be a better UX, but more would be a worsening UX.
- ▶ Frames Per Second (FPS): ESRI stated that 30FPS is what most users perceive as a good UX, 60 is optimal but most users do not see a significant difference.
- ▶ FPS Minimum: ESRI stated that a drop below 5-10FPS would appear to an end user that the drawing had stopped or “frozen”.
- ▶ Standard Deviation: This would represent the number of tests that were outside the average of the others, typically representing a faulty test. Values should be <2 for 2D and <4 for 3D workloads.



After initial testing it was clear that Draw Time Sum would be inside its acceptability threshold if the other three metrics were also inside their respective metrics. This gave us a single value to track, and then validate the rest of the results were within acceptable ranges as well.

### 9.5.2 Real life experience verses benchmarking

Our goal is to find the most accurate possible proxy for testing, but this is still not the same as real users doing real work on real data. The NVIDIA GRID Performance Engineering Labs is committed to working with customers to find more and better models, and field confirmation of findings.

### 9.5.3 The importance of eyes on!

Its important to view the tests to be sure the experience is in fact something a user would enjoy. We discovered that the initial tests did not contain panning, or “Navigation”, something that users do on a common basis. In adding this functionality to the “Heavy 3D + Increased Think Time” tests resulted in a drop from the maximum 16 users down to 12.

## 9.6 TESTING METHODOLOGY

To ensure you will be able to reproduce our results, we have deliberately chosen a peak workload and run simultaneous tests. Meaning all testing virtual desktops are doing the same activities at the same time, a “Peak Workload” that should be unrealistic of real user interaction but shows the number of users per host when extreme demand is put on the shared resources. This gives us one end of the spectrum.

In the case of ArcGIS, we focused on rendering pipeline (DirectX 11 based) to determine the impact of GPU on performance on scalability. OpenGL testing will be covered in future guides.

These tests did not focus on analytics, as this is more impactful on networking (assuming remote data) and CPU. We intend to test analytics operations in the future. Given ArcGIS Pro is synchronous you can render while running analytics in the background. The impact of this will need to be tested.

- ▶ Sample workload: ESRI provided their “Philly 3D” workload for us to test with. This test is described by ESRI as representative of a “heavy 3D” map.
- ▶ Rendering vs Analytics:

- ▶ Scripting: ESRI provided scripting designed to run the application through several benchmarks. In later passes we added panning (“Navigation”) to the script to better imitate end user behavior when viewing a map.
- ▶ Think Time: The ESRI script allowed for “think time” adjustment, we started with the default of 2 seconds, then adjusted to 5 seconds, then tried 10, this to imitate time a user might think before selecting another bookmark in the test.
- ▶ Scalability: scripting also allowed for test runs of as many virtual desktops as required. In general we run 1, then 8, then 16, to get a baseline of results and accompanying logs (CPU, GPU, RAM, networking, storage IOPS, etc.).

## 9.7 RESULTS OVERVIEW

### ▶ vCPU:

ESRI stated that ArcGIS is CPU bound, meaning it relies heavily on the CPU to perform and this will be the shared resource most likely to bottleneck first. Based on physical spec above we chose 4 vCPUs/virtual desktop to start, then tested with 6 and 8 vCPUs respectively.

- *Result: Our testing found 4 vCPUs performed the best based on the benchmarks ESRI provided.*

### ▶ vRAM:

ESRI stated they are not RAM intensive, based on recommended specifications we started with 6GB/virtual desktop. During testing we also tested with 4GB of RAM, but this caused CPU spikes, we determined this was caused by the application requiring 5+GB of RAM to load the “Philly 3D” dataset. Tests with 8GB of RAM per virtual desktop did not produce improved performance. You should base the amount of RAM on the needs of your actual workloads.

- *Result: For this workload  $\geq 6GB$  of RAM is required.*

### ▶ GPU

ESRI states that a GPU is required for 3D workloads, we ran tests with servers hosting either pairs of K1 or K2 cards. A test with the full GPU and all 4GB of frame buffer, the K280Q profile, offered high performance but lacked scalability, limited to 4 virtual desktops in our two K2 host. We then tested with the K260Q profile and its 2GB of frame buffer, up to its maximum of 8 users (4/K2 card) it was still within the metrics provided by ESRI. This meant there was room for more users if we lowered frame buffer to 1GB via the K240Q profile. We also tried the K220Q profile and its 512MB of frame buffer, but this was too little VRAM and caused CPU swapping impacting performance and scalability, and proved GPU is necessary.

- *Result: For ArcGIS Pro performance AND scalability, the K240Q profile was best.*

#### ► Storage

We used iSCSI attached SAN over 10G non-trunked networking. Our tests never exceed ~25,000 IOPS.

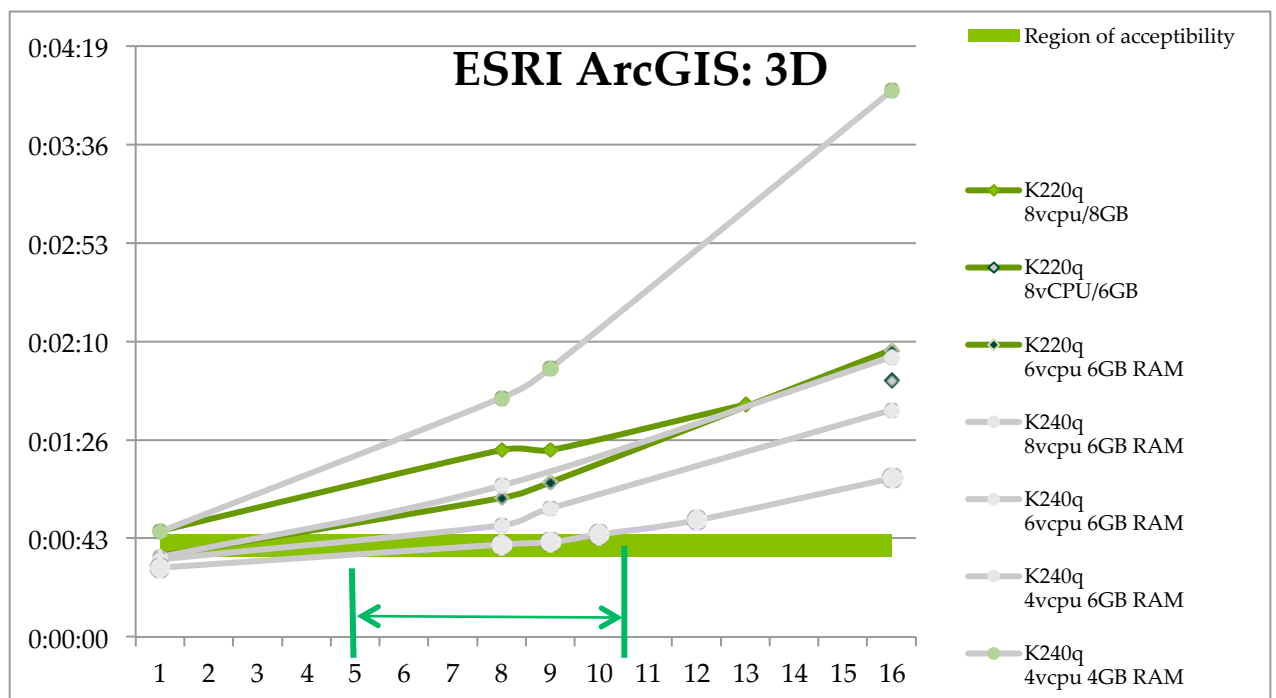
- *Result: Clearly local spindle bound storage would have been a bottleneck and impacted performance, the fast cache SAN handled the IOPS load.*

#### ► Networking

We used 10G, and 1GB distribution, networking, at no time was networking a bottleneck and results were unremarkable.

## 9.8 RESULTS

The following are the full results of our testing. Beginning with a graph showing the region of acceptability as a green bar, times above this region are a worsening UX, below would be a better UX. Looking for both performance and scalability, as the line for the profile moves above the region of acceptability this becomes the greatest scalability while still within performance expectations. Its important to note that your users, your data, and your hardware, will impact these results and you may decide a different level of performance or scalability is required to meet your individual business needs.



Detailed results:

VM Config	VM count	DrawTime (min:sec)	FPS	Min FPS	Std deviation
K220q 8vcpu/8GB	1	00:46.5	52.25		
	8	1:22	39.33		
	9	01:45.1	16.07	3.12	12.3
	13	1:42	30.87		
K220q 8vCPU/6GB	16	01:52.8	31.45	3.2	17.9
K220q 6vcpu 6GB RAM	1	00:35.6	52.25	12.25	
	8	1:01	34.62	5.8	7.2
	9	01:07.8	31.87	4.87	13.32
	16	2:06	20.77	3.34	23.45
K240q 8vcpu 6GB RAM	1	0:00:35	59.95	13.86	
	8	0:01:06	53.34	8.09	21.99
	16	0:02:03	47.79	3.8	4.74
K240q 6vcpu 6GB RAM	1	34.41	60.03		
	8	00:49.0	51.48	7.3	3.6
	9	00:56.4	50.77	6.8	3.48
	16	01:39.6	46.60	4.52	6.27
K240q 4vcpu 6GB RAM	1	00:30.3	61.84	17.75	
	8	00:40.6	49.76	11.45	1.45
	9	00:41.6	46.87	10.21	3.2
	10	00:45.0	45.76	9.46	2.62
	12	00:51.2	40.31	7.54	6.3
	16	01:09.6	37.52	5.3	2.7
K240q 4vcpu 4GB RAM	1	0:00:46	59.94	16.7	
	8	0:01:45	52.67	14.51	8.67
	9	0:01:58	51.39	15.4	9.23
	16	0:04:00	45.84	15.48	25.8
K240q 4vcpu 6GB RAM Think Time 5 Seconds	1	00:30.2	60.02	24.81	
	8	00:34.0	57.05	14.15	0.79
	12	00:38.1	52.87	12.00	1.2
	16	00:46.0	49.55	9.85	2.8
K240q 4vcpu 6GB RAM Think Time 5 Seconds Navigation Time 5 Second (Panning and Zooming)	1	01:11.2	62.34	21.96	
	8	01:15.9	53.45	14.15	1.9
	12	01:22.6	45.35	8.65	2.9
	16	01:32.8	40.65	6.00	3.7

# Chapter 10.

## CREATING YOUR FIRST vGPU VIRTUAL DESKTOP

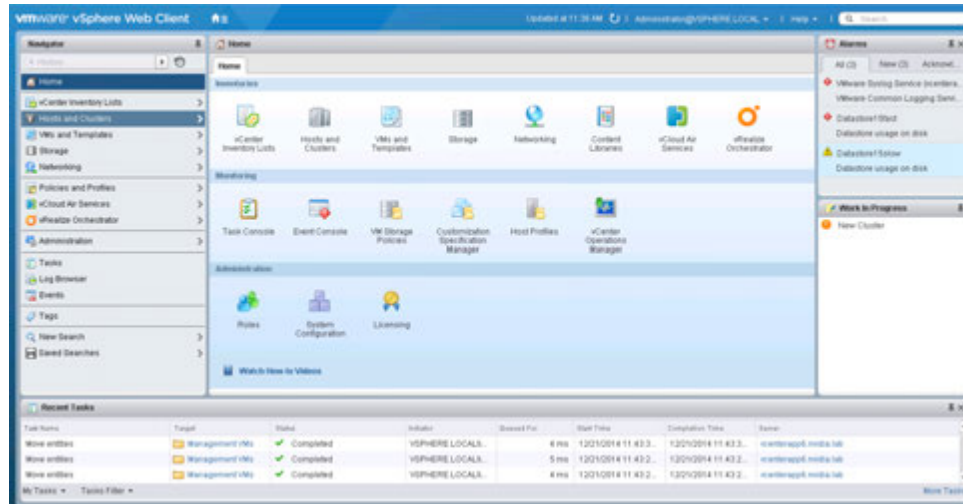
This chapter describes how to:

- ▶ Create and configure a virtual machine in vSphere
- ▶ Install Windows and VMware Tools on the VM
- ▶ Customize Windows settings
- ▶ Install Horizon Agent and Horizon Direct Connection on the VM
- ▶ Adjust some additional VM settings and enable VM console access
- ▶ Enable the NVIDIA vGPU and finalizing the installation

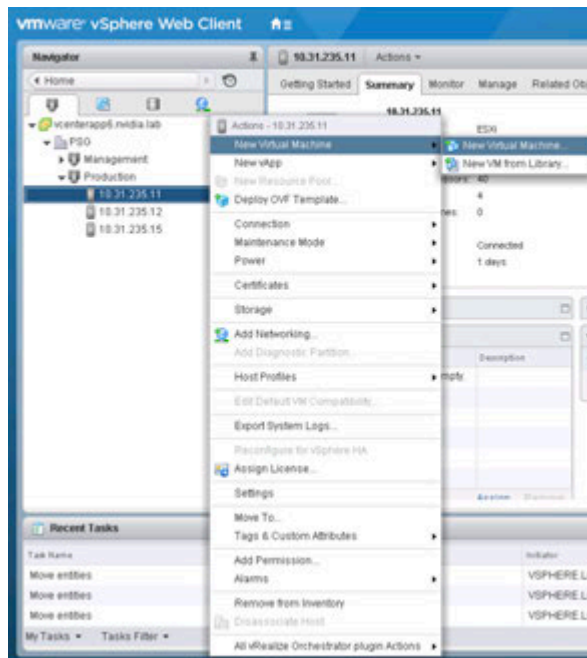
### 10.1 CREATING A VIRTUAL MACHINE

These instructions are to assist in making a VM from scratch that will support NVidia vGPU. Later the VM will be used as a gold master image. Use the following procedure to configure a vGPU for a single guest desktop:

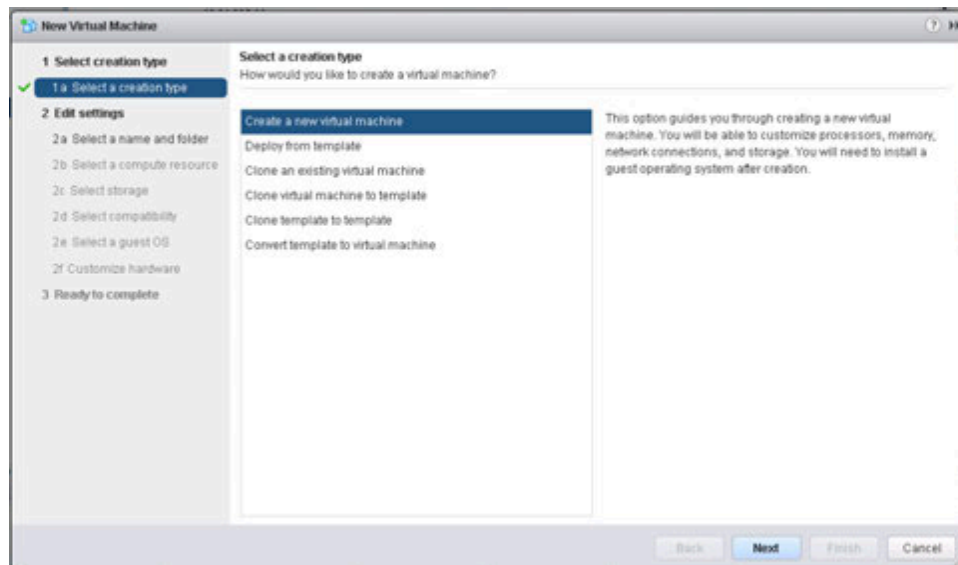
1. Browse to the host or cluster using the *vSphere Web Client*.



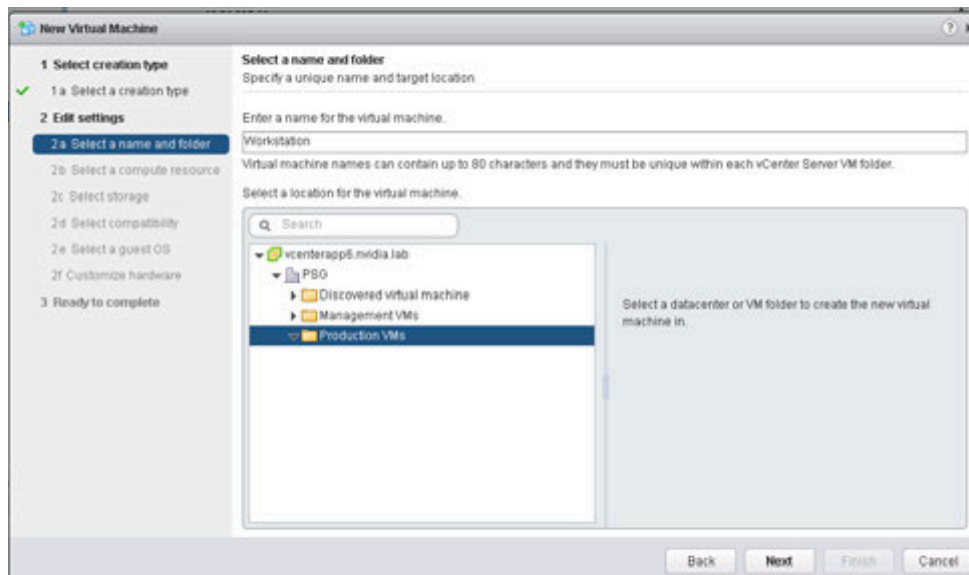
- Right-click the desired host or cluster and select **New Virtual Machine**. The *New Virtual Machine* wizard begins.



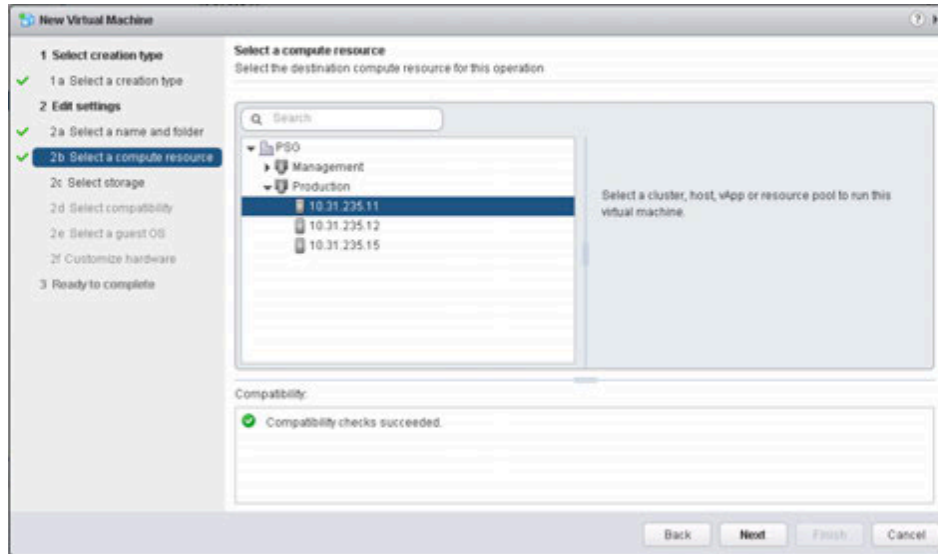
3. Select **Create a new virtual machine** and click **Next**.



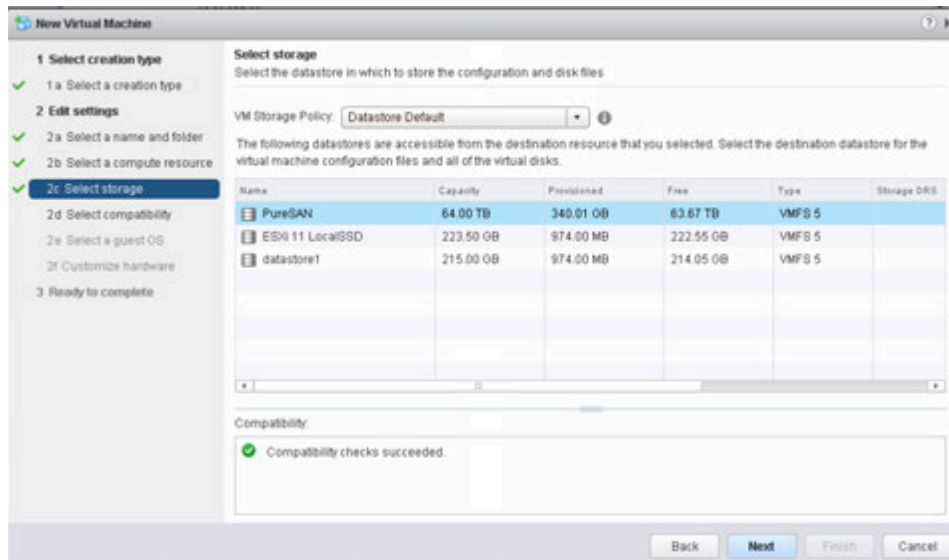
4. Enter a name for the virtual machine. Choose the location to host the virtual machine using the **Select a location for the virtual machine** section. Click **Next** to continue.



5. Select a compute resource to run the VM. Click **Next** to continue. **NOTE:** This compute resource should include an NVIDIA GRID K1 or K2 card installed and be correctly configured.

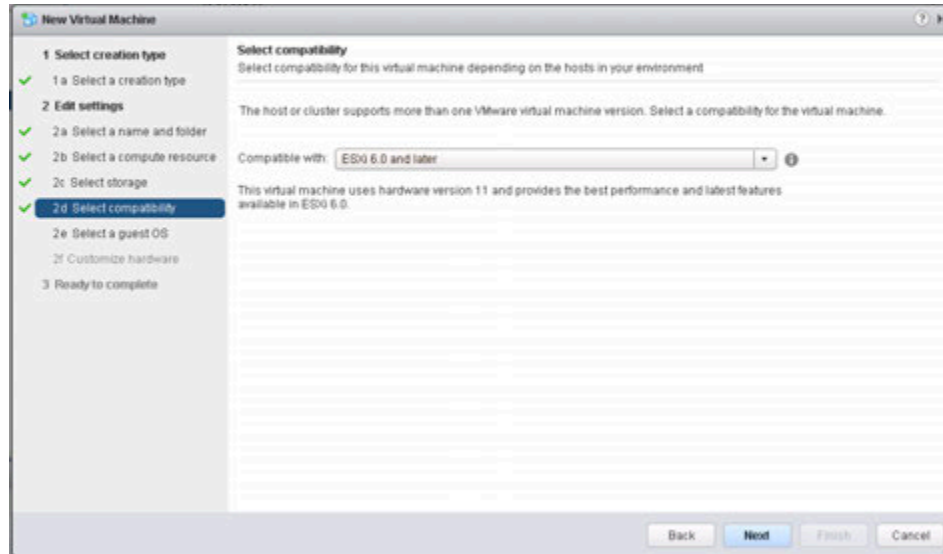


6. Select the datastore to host the virtual machine. Click **Next** to continue.

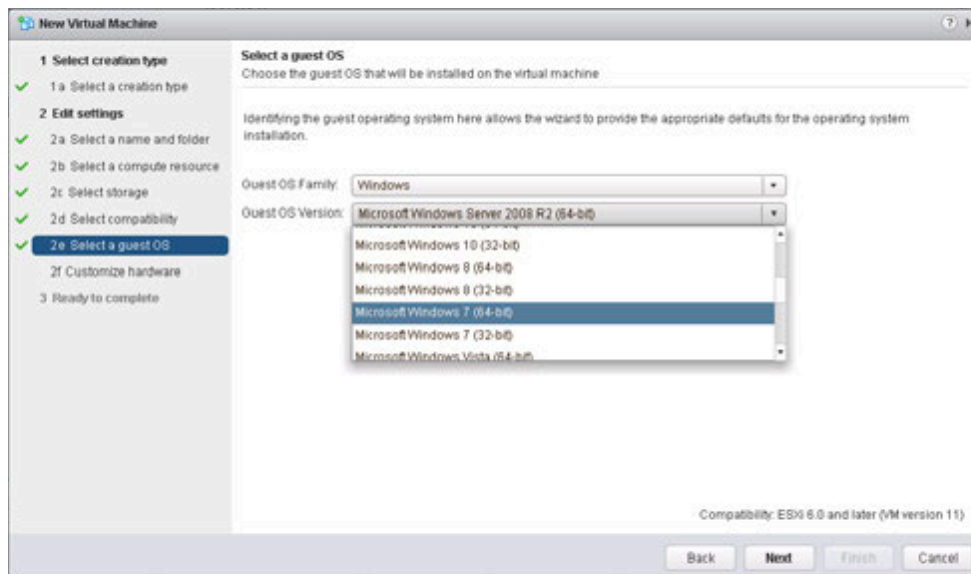


7. Select compatibility for the virtual machine. This allows VMs to run on different versions of vSphere. In order to run vGPU select ESXi 6.0 and later. Click **Next** to continue.

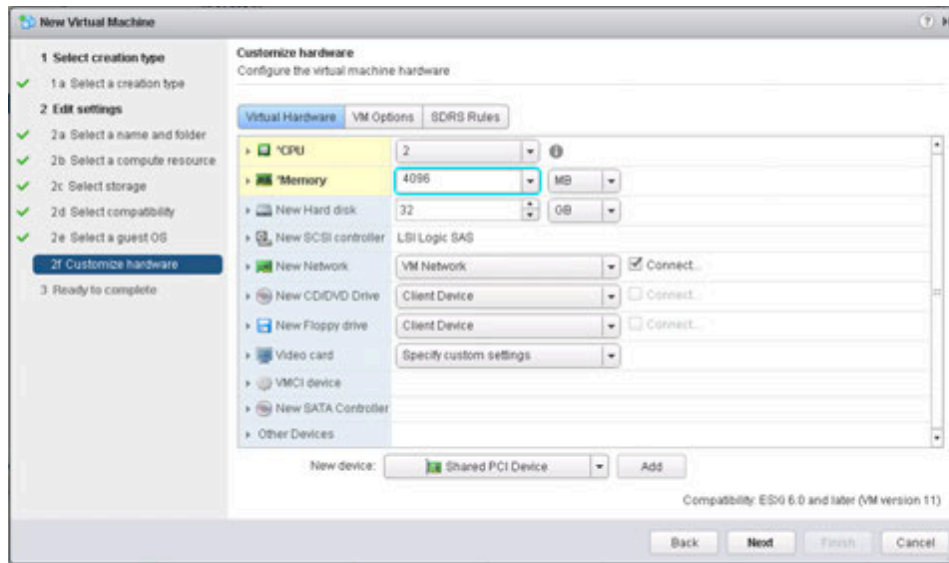




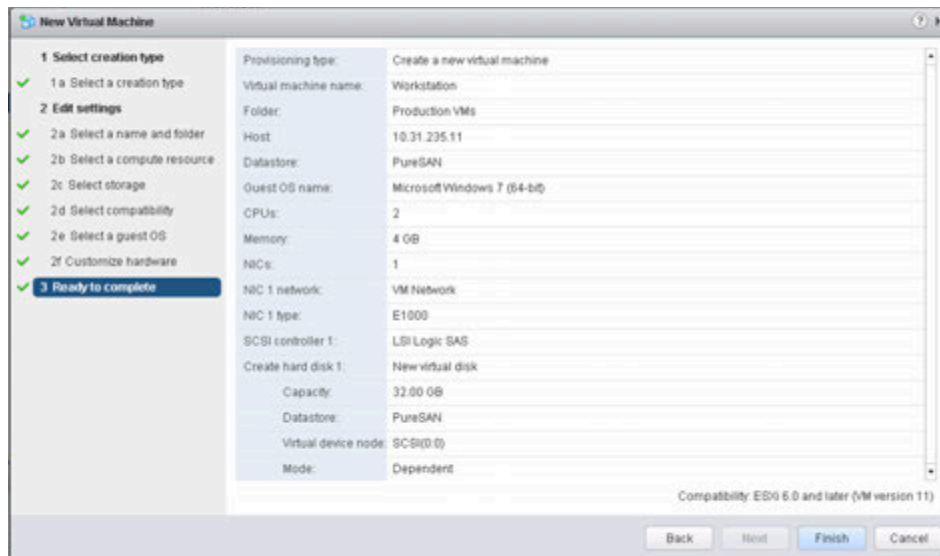
8. Select the appropriate Windows OS from the **Guest OS Family** and **Guest OS Version** pull-down menus. Click Next to continue.



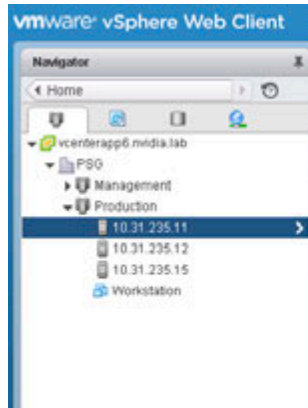
9. Customize hardware is next. Set the virtual hardware based on your desktop workload requirements. Click Next to continue.



10. Review the New Virtual Machine configuration prior to completion. Click **Finish** when ready.



The new virtual machine container has now been created.

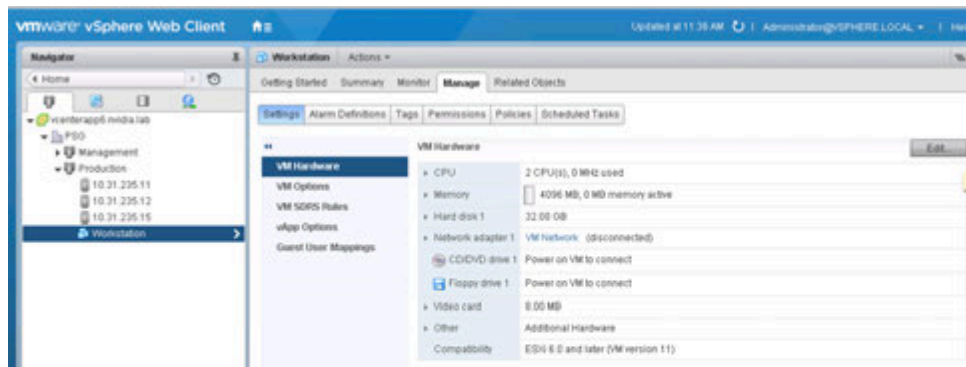


Installation of the guest OS inside the VM is next.

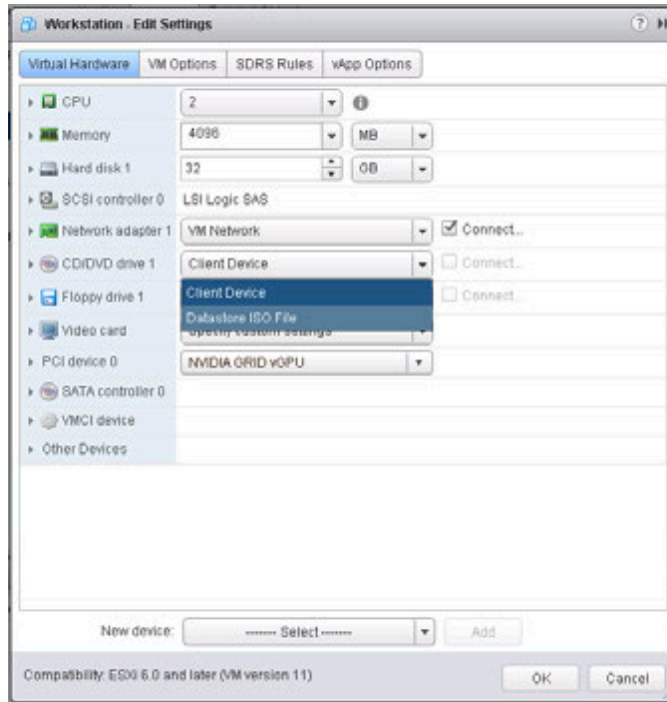
## 10.2 INSTALLING WINDOWS

Use the following procedure to install Windows on the virtual machine:

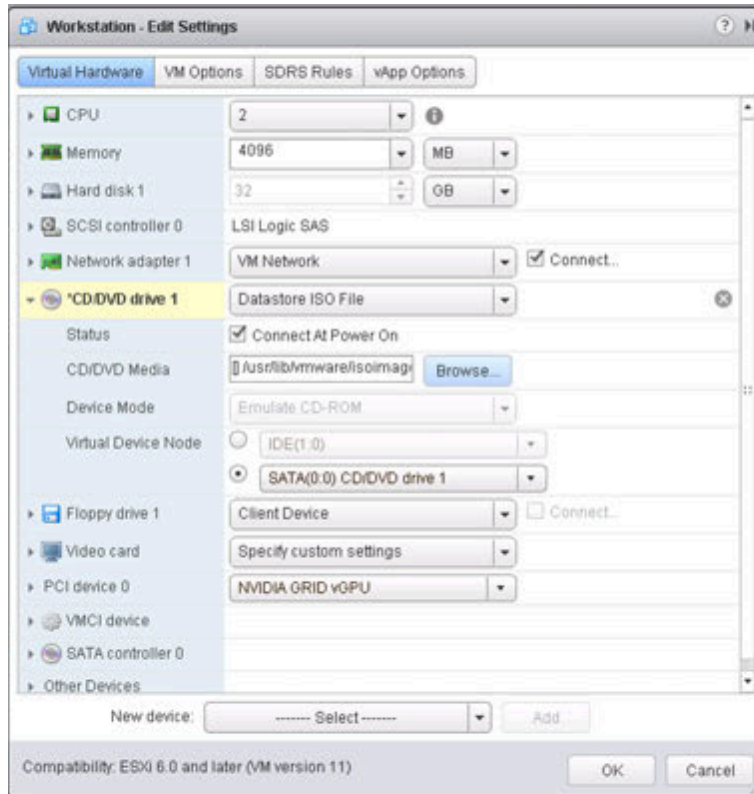
1. Select the virtual machine, click on the Manage tab and select Settings. Click on the Edit button.



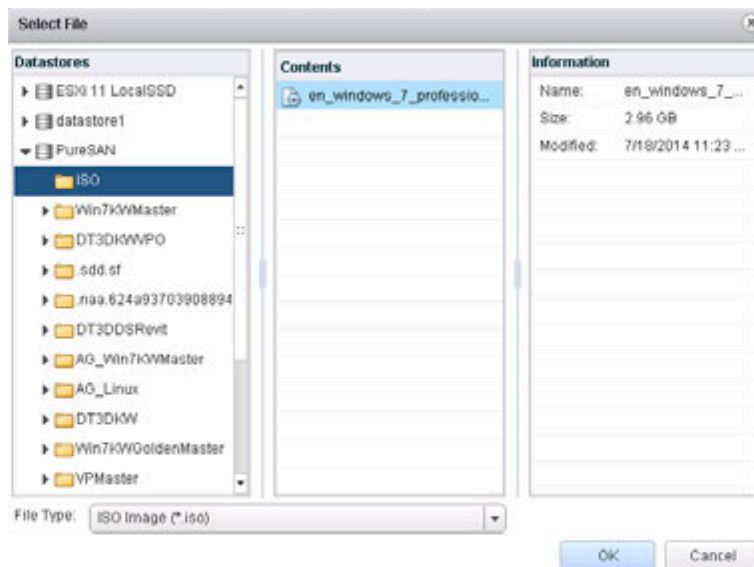
2. Locate the CD/DVD entry under the Virtual Hardware tab. Select the arrow drop down to reveal data sources for the CD/DVD media. (In this example a Datastore ISO file will be used.) Check the **Connect** checkbox for **CD/DVD drive 1**. This will connect the ISO file to the VMs virtual CD/DVD drive.



3. Toggle the carrot next to the CD/DVD drive 1 icon to reveal the details of the virtual device. For Status check the **Connect At Power On** checkbox. This will connect the ISO file to the VM's virtual CD/DVD drive during boot up. Next Click on the Browse button for the CD/DVD Media.



4. Navigate to and select the OS ISO file to be used for install. Click OK to select the ISO.



5. Right-click the virtual machine, and then select **Power>Power On** to start the virtual machine and boot from the .ISO to install the operating system.  
The virtual machine boots from the selected .ISO.



If you are creating a new virtual machine and using the vSphere Web Client's VM console functionality, then the mouse may not be usable within the virtual machine until after the both the operating system and VMware tools have been installed.

6. Perform a Custom (fresh) installation of Windows 7 on the virtual machine. During installation, Windows reboots the VM several times.
7. Disconnect the .ISO from the VM when Windows is done installing.
8. Go through the initial Windows setup wizard to name the computer, create a local account, set the timezone, choose update installation policy, etc.  
Windows 7 is now installed on the virtual machine.

## 10.3 INSTALLING VMWARE TOOLS ON THE VM

After Windows completes the initial installation and configuration process, the next step is to install VMware Tools on the virtual machine.

1. Select the **Summary** tab from the virtual machine console.
2. Click the **Install VMware Tools** link in the yellow bar.  
The *Install VMware Tools* window displays.



3. Click **Install VMware Tools**.  
Back in the virtual machine console, Windows 7 detects the CD image and the *AutoPlay* window should open. If not, browse to the virtual CD-ROM in the virtual machine and access it manually.

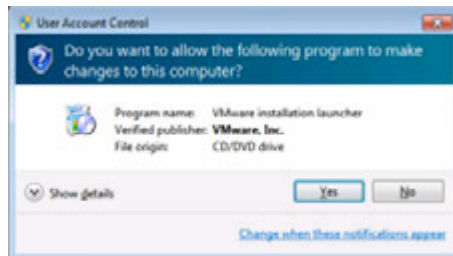
32-bit installer:



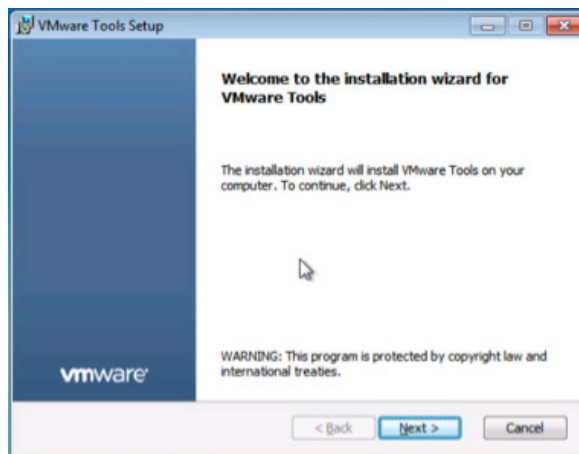
64-bit installer:



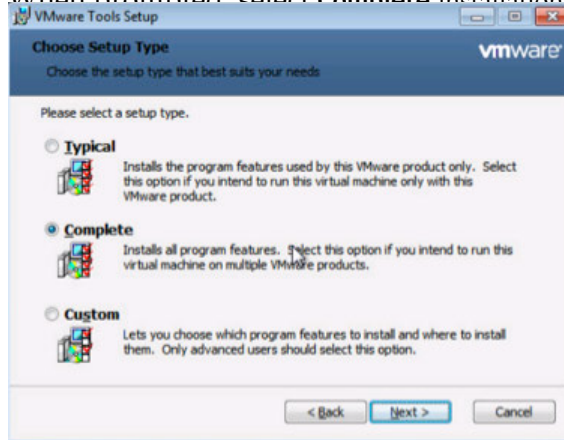
4. Click **Run setup.exe** or **setup64.exe**.  
The *User Account Control* popup may display.



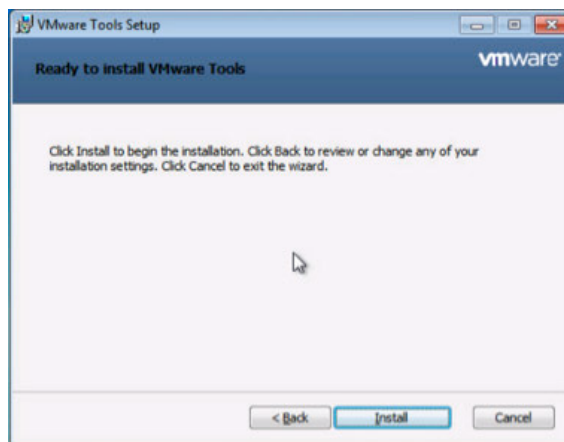
5. If UAC prompts, then click **Yes**.
6. The installer begins, click **Next**.



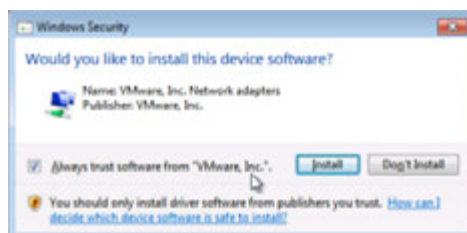
7. When prompted, select **Complete** installation, click **Next**, and accept all defaults.



8. When prompted, select **Install** to begin installation:

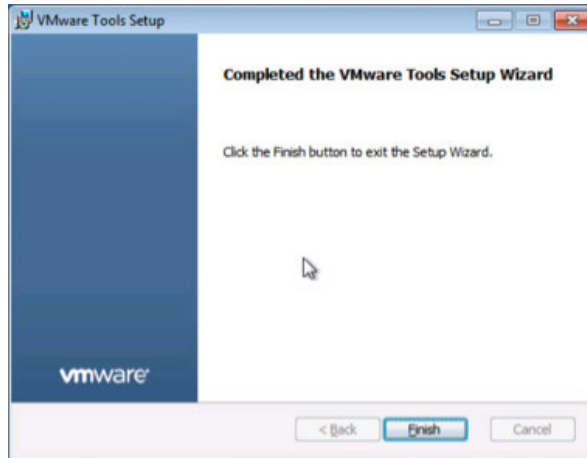


9. Check the **Always trust software from "VMware, Inc."** checkbox and click **Install** to continue.



10. The *Set Network Location* window may display, if so then select **Work Network**.
11. Click **Finish** in the VMware Tools installer and reboot the virtual machine when prompted. This reboot is critical to ensure the tools are now the loaded drivers.

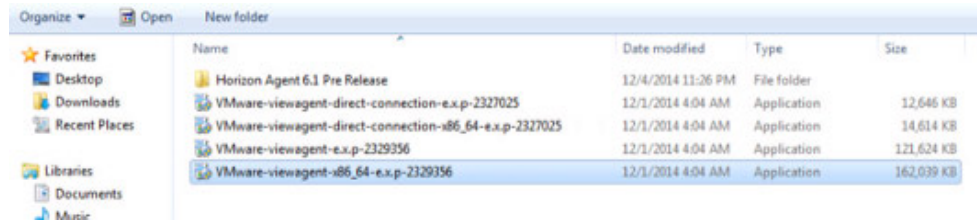




VMware Tools is now installed on the virtual machine

## 10.4 INSTALLING HORIZON AGENT

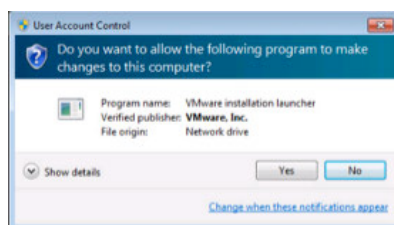
You need to install the correct version of the Horizon Agent for your virtual machine:

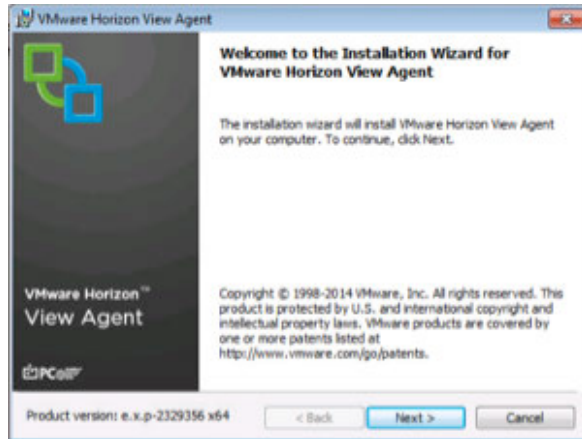


- ▶ For 32-bit virtual machines: VMware-Horizonagent-6.1.exe
- ▶ For 64-bit virtual machines: VMware-Horizonagent-x86\_64- 6.1.exe

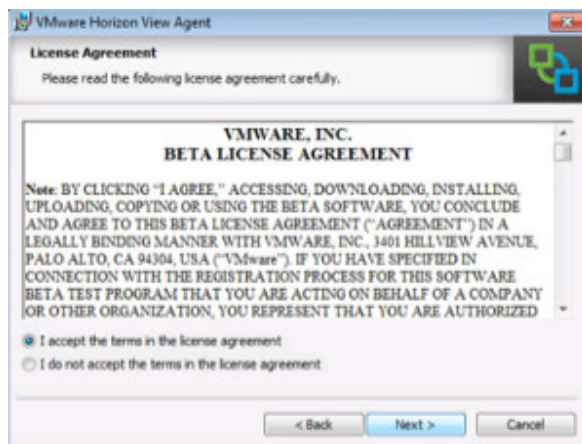
Use the following procedure to install Horizon Agent on the virtual machine:

1. Launch the installer.  
The *Welcome* window displays.

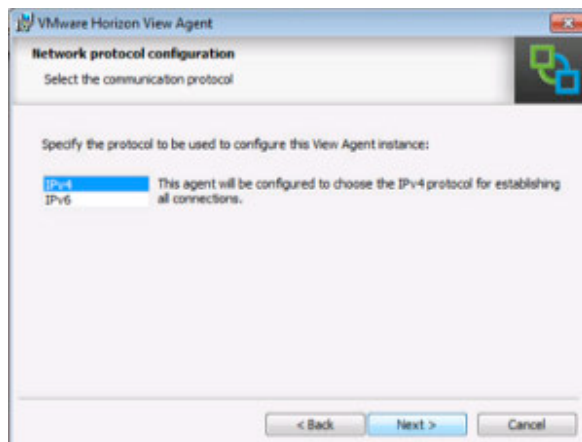




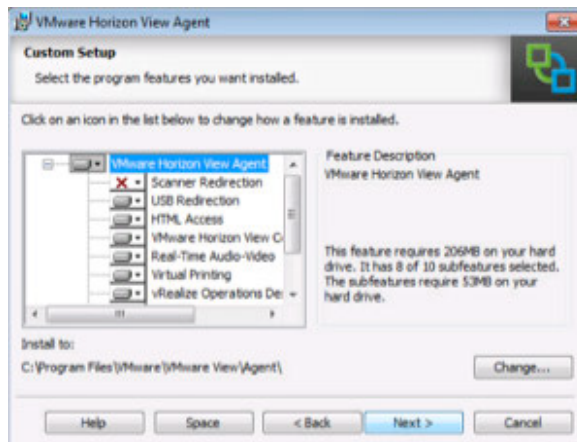
2. Click **Next** to proceed.  
The *License Agreement* window displays.



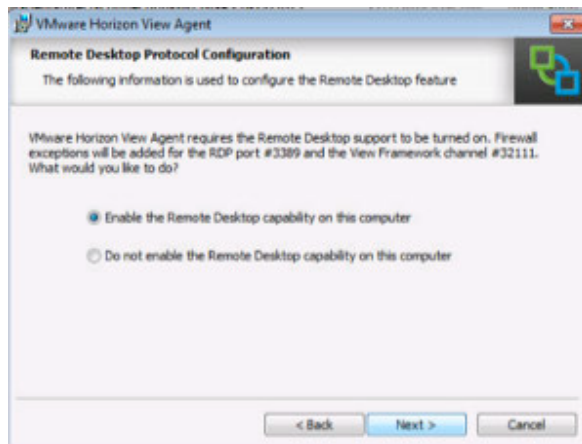
3. Check the **I accept the terms** in the license agreement radio button, click **Next** to proceed.
4. *Network protocol configuration* window appears, choose the appropriate network protocol, typically this is IPv4, and click **Next** to proceed:



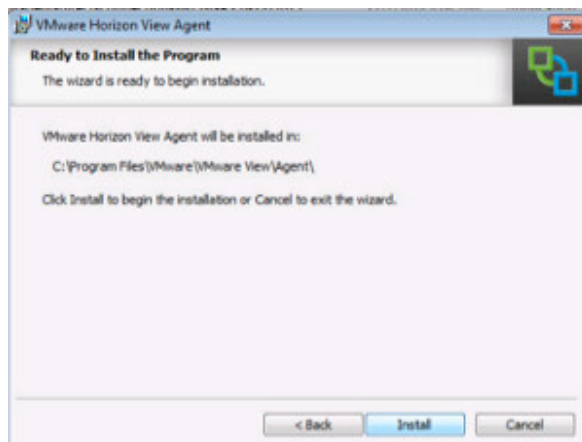
5. The *Custom Setup* window displays.



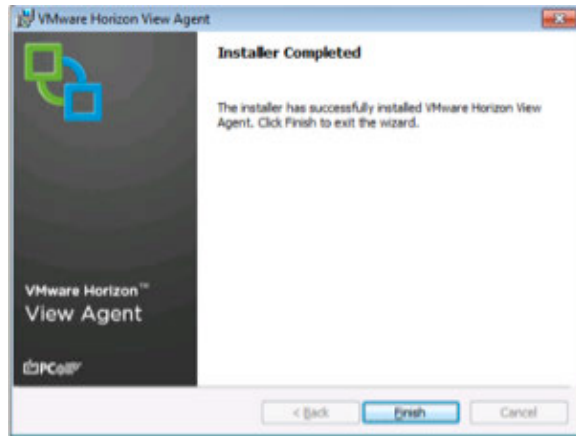
6. Accept all defaults values by clicking **Next**.
7. Enable remote desktop capability if prompted to do so.



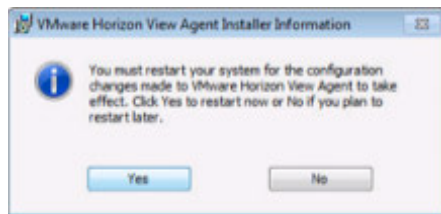
8. The *Ready to install the program* window displays.



9. Click **Install** to proceed
10. Horizon Agent installs on the virtual machine and the *Installer Completed* window displays when the installation process concludes.



11. Click **Finish** to exit the installer.
12. Reboot the virtual machine when prompted to do so.



VMware Horizon Agent is now installed on the virtual machine

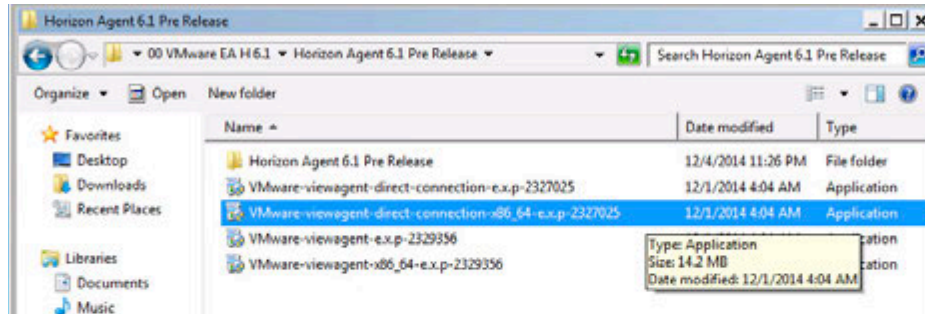
## 10.5 INSTALLING HORIZON DIRECT CONNECTION

For debugging purposes while configuring VM's with vGPU, install the correct version of Horizon Direct Connection agent for your virtual machine, it is provided with the Horizon 6.1:

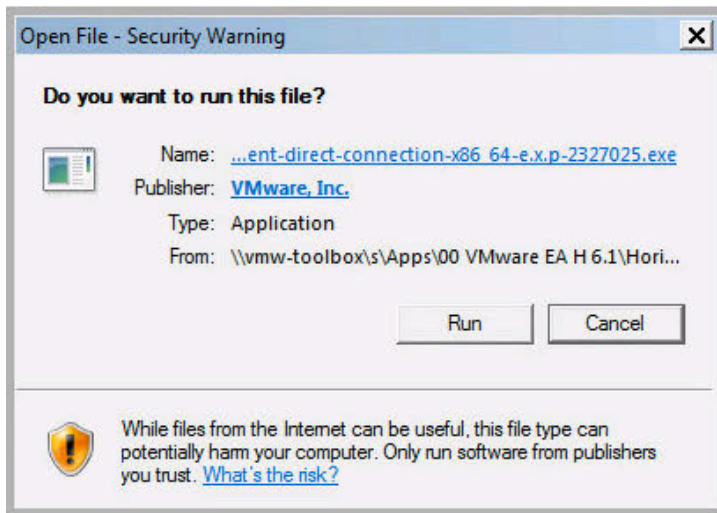
- For 32-bit virtual machines: VMware-Horizonagent-direct-connection-xxx.exe
- For 64-bit virtual machines: VMware-Horizonagent-direct-connection-x86\_64-6-xxx.exe

Use the following procedure to install Horizon Direct Connection on the virtual machine:

1. Launch the installer.

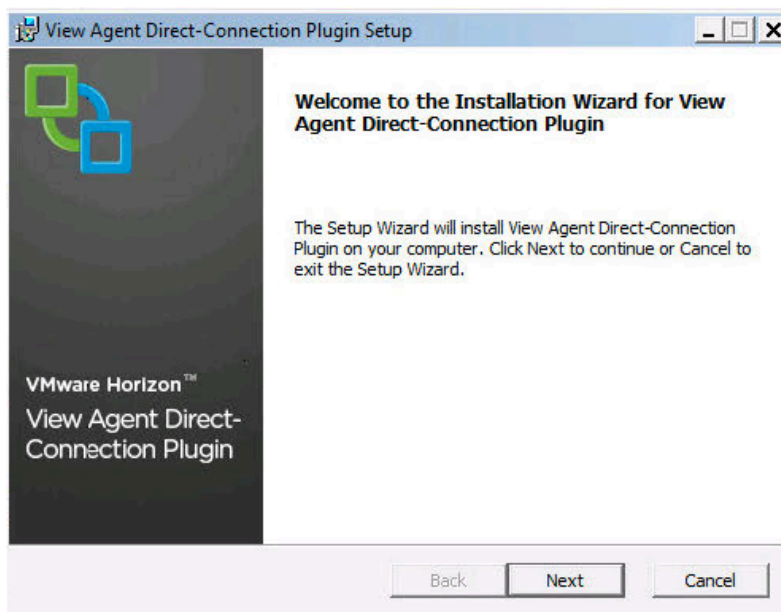


2. Select Run if an Open file – Security Warning appears.



- 3.

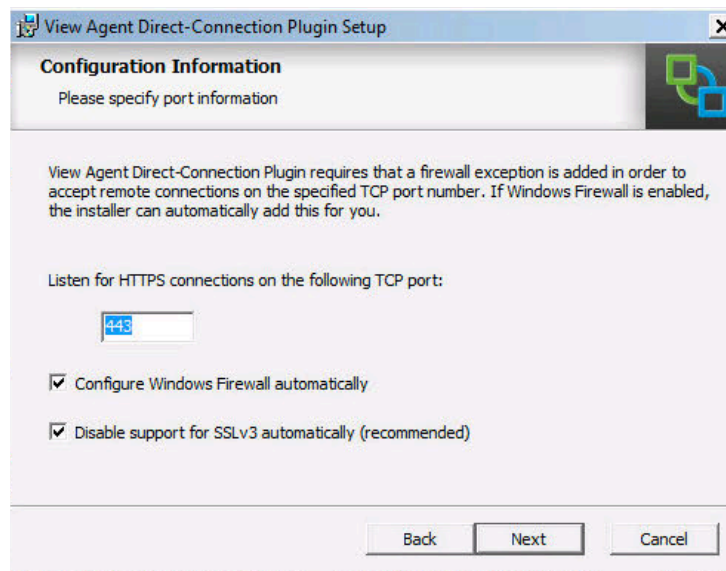
4. Click **Next** to proceed.



5. Check the **I accept the terms in the license agreement** radio button. Click **Next** to continue.



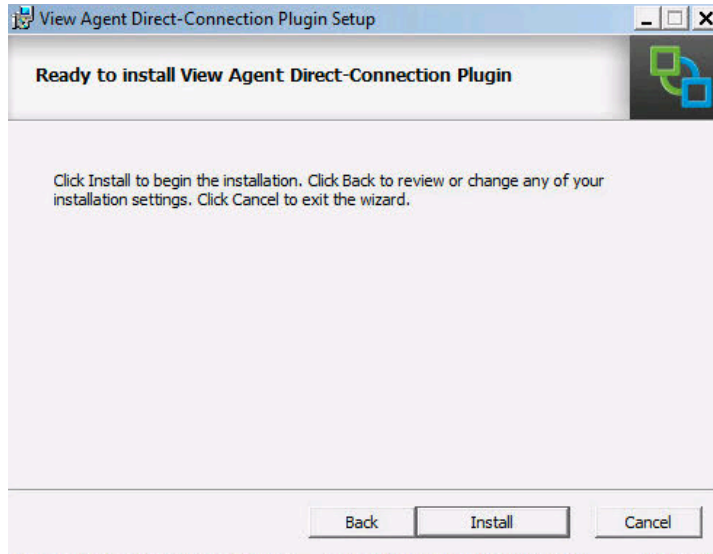
6. Enter port number 443 in the **Listen for HTTPS connections** field. Check the **Configure Windows Firewall automatically** checkbox. Click **Next** to proceed.



The default HTTPS port is 443; however, you may use a different port if desired.

7. The *Ready to install the program* window displays. Click **Install** to proceed.





8. Click **Finish** to exit the installer, and then reboot the virtual machine when prompted to do so.
9. Test **Direct Connection** using latest VMware Horizon Client by adding a server, entering the IP address of the virtual machine, and logging on to the virtual machine with the appropriate credentials when prompted.

Horizon Direct Connection is now installed on the virtual machine

## 10.6 OPTIMIZING WINDOWS

Use the VMware OS Optimization Tool to optimize Windows 7/8/2008/2012 systems for use with VMware Horizon View. The optimization tool includes customizable templates to enable or disable Windows system services and features, per VMware recommendations and best practices, across multiple systems. Since most Windows system services are enabled by default, the optimization tool can be used to easily disable unnecessary services and features to improve performance.

You can perform the following actions using the VMware OS Optimization Tool:

- ▶ Local Analyze/Optimize
- ▶ Remote Analyze/Optimize
- ▶ Optimization History
- ▶ Managing Templates

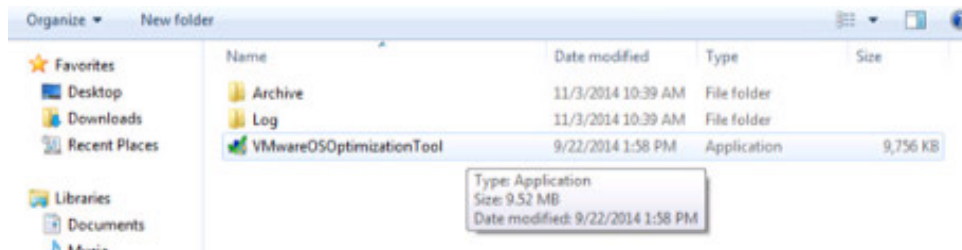
Review the *VMware Horizon Optimization Guide for Windows 7* for OS-specific tweaks. This document is available from <http://www.VMware.com/files/pdf/VMware-View-OptimizationGuideWindows7-EN.pdf>.



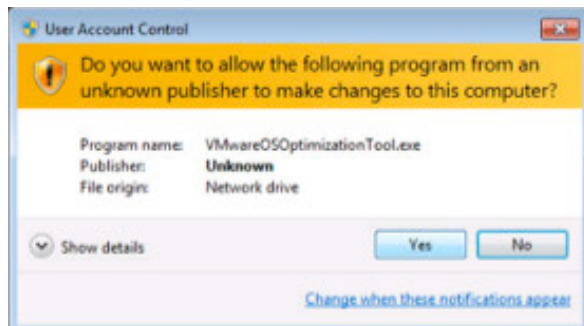
Do not run the batch files recommended in this document without understanding the changes they make, as they may disable more functionality than anticipated.

To install the optimizer:

1. Download and then browse to the folder containing the VMware OS Optimizer Tool, double click on *VMwareOSOptimizerTool.exe* to run it.

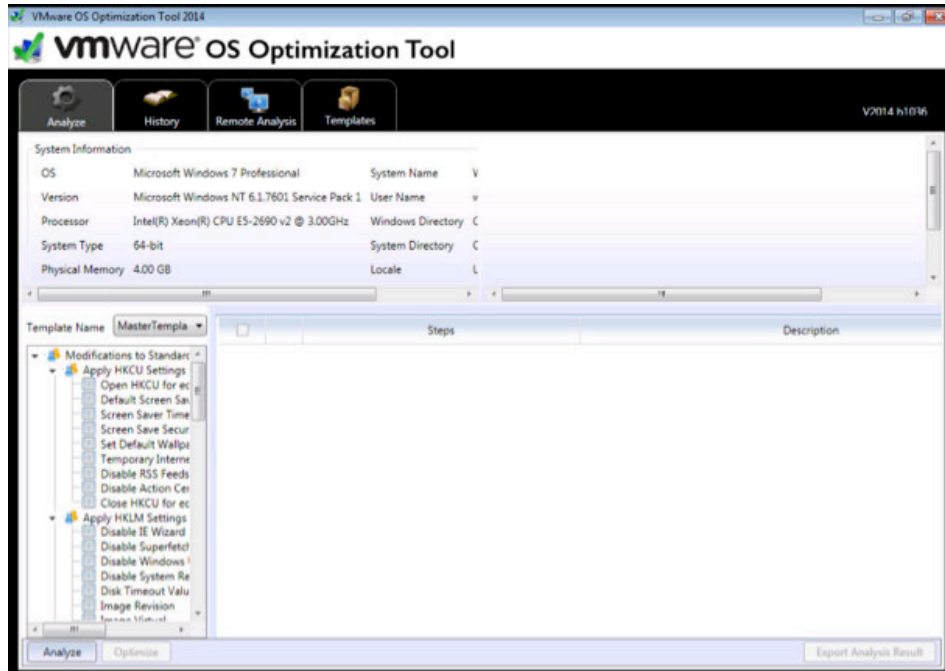


2. The Microsoft User Account Control pop-up may appear, if so click **Yes** to continue.

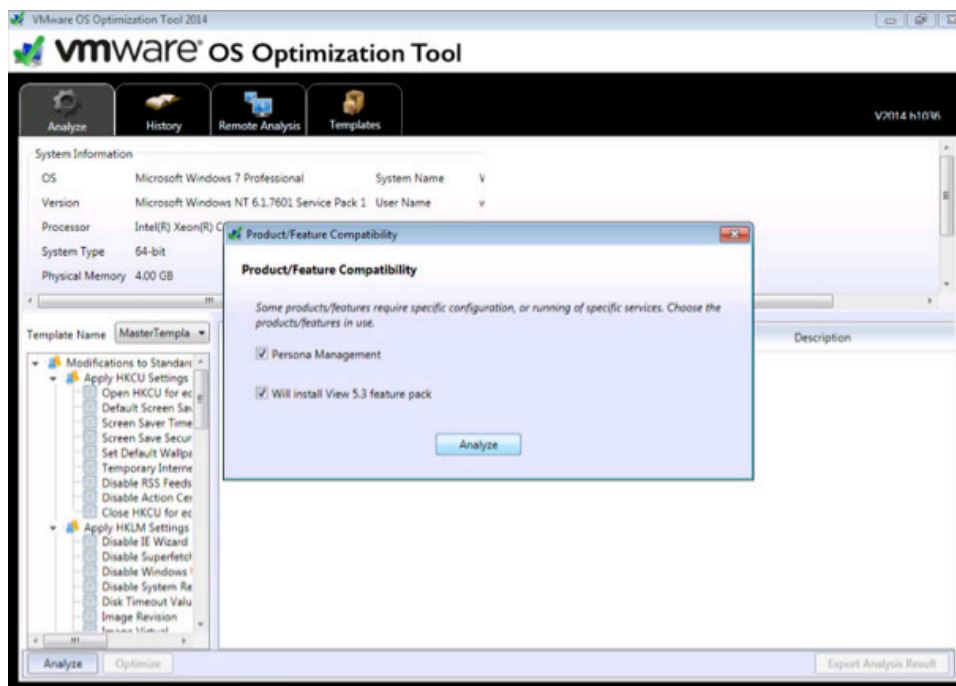


3. The tool opens and displays the Analyze tab with System Information, click the **Analyze** button at the bottom left to begin:

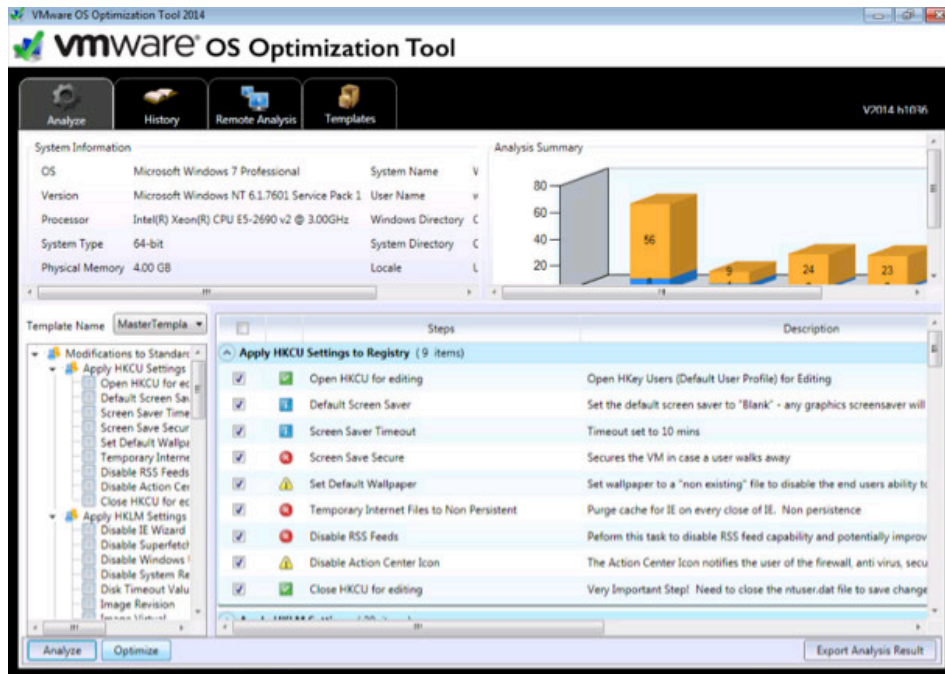




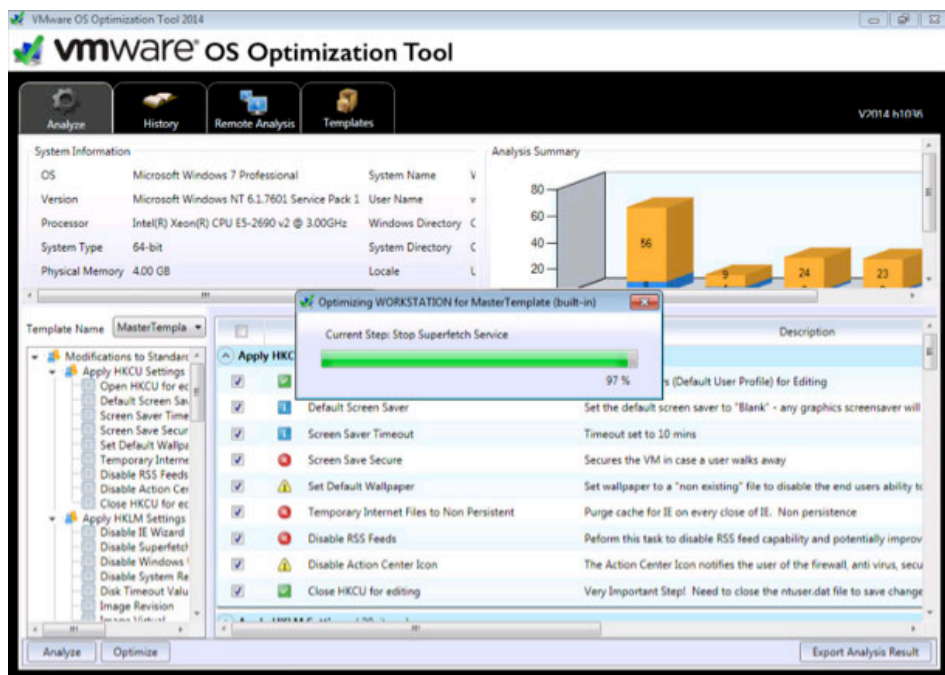
4. The Product/Feature Compatibility pop-up appears, select both and click **Analyze**:



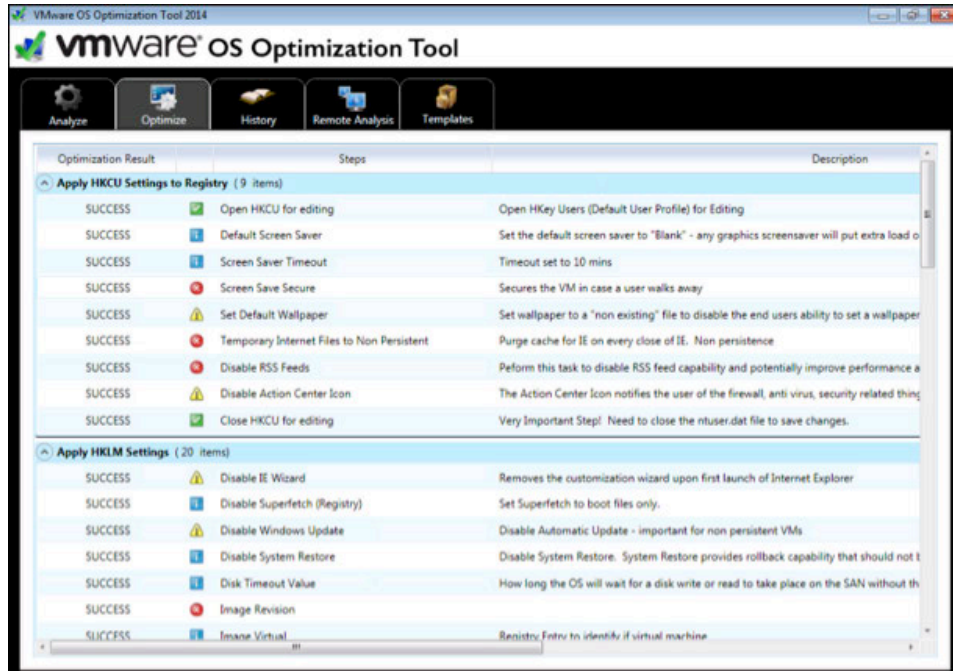
5. Upon completion the main window will show the results, and there is now an Optimize button at the bottom left:



6. Scroll through and select or deselect any of the optimizations depending on your needs, we chose the defaults. Click **Optimize** and the tool will run the selected scripts to optimize the workstation:



7. The results page shows once the process is complete:



## 10.7 ADDING THE GOLDEN MASTER TO THE DOMAIN

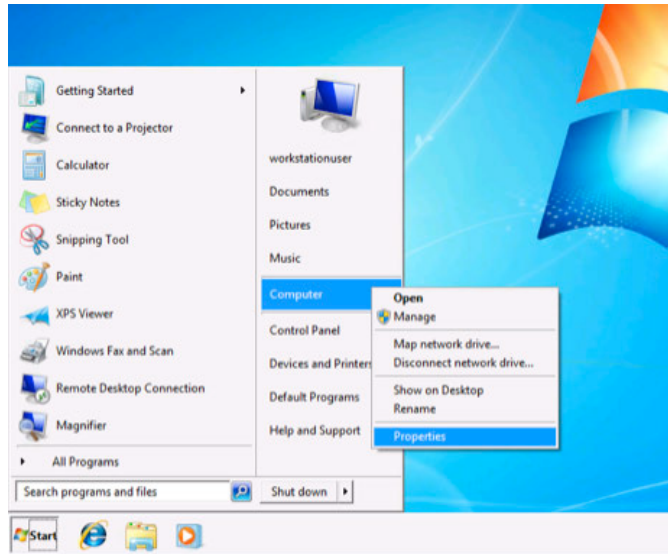
By joining the VM to the Windows Active Directory domain you are then able to manage it as you would any physical desktop in the domain.

Customize Windows on the virtual machine as follows:

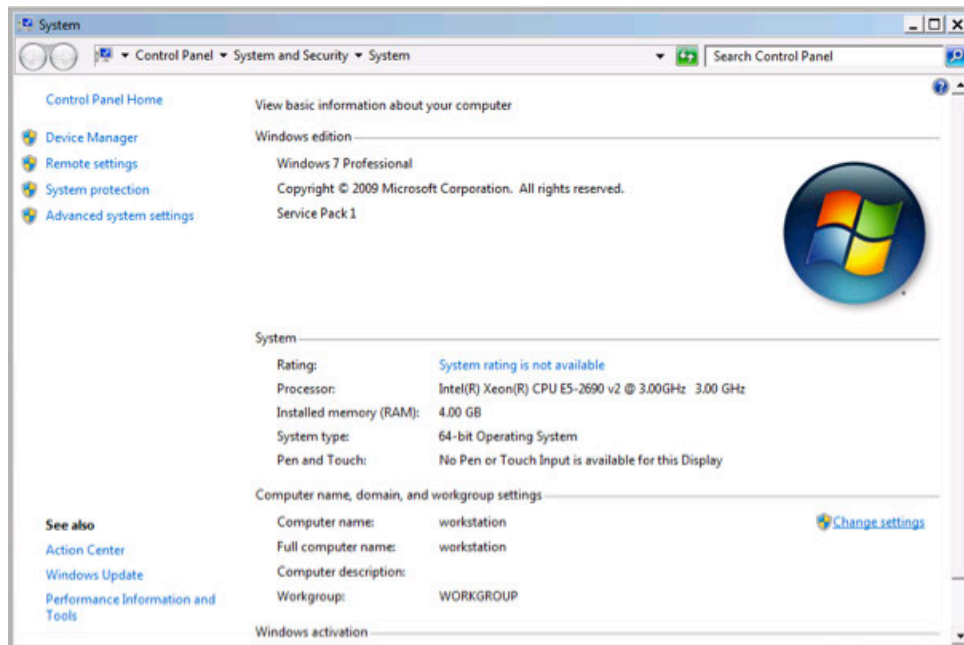
- Join the domain
- Add appropriate Domain groups to Local Administrators

Adding a VM to the domain:

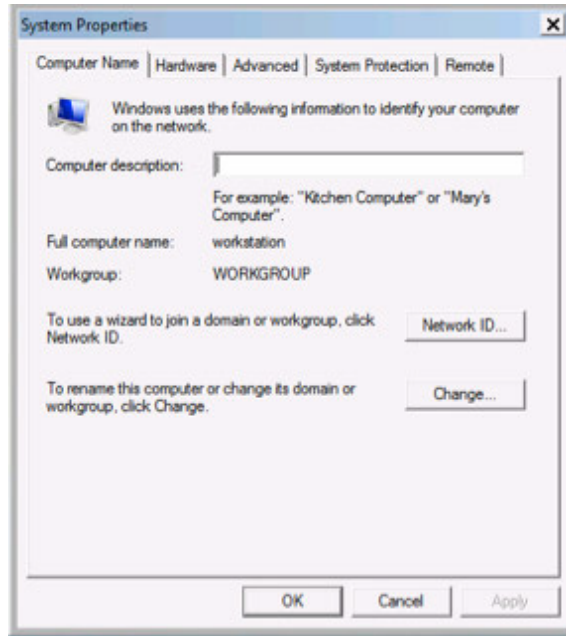
1. On the VM, click Start, then right click on Computer to bring up its menu, click Properties:



2. On the Properties window, click Change settings:



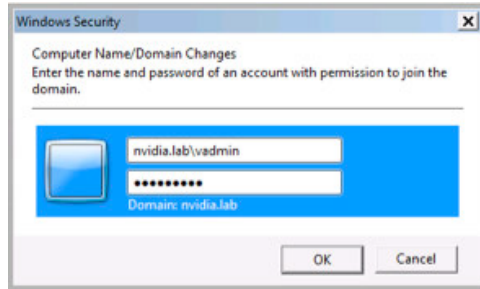
3. This brings up the System Properties window, on the Computer Name tab click Change:



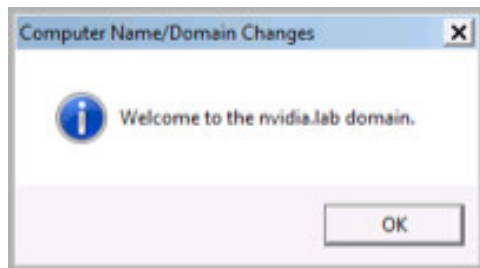
4. On the Computer Name/Domain Changes window, enter in an appropriate Computer name, then Domain name, and click OK. Our chosen naming is shown below, use what is appropriate for your POC/trial.



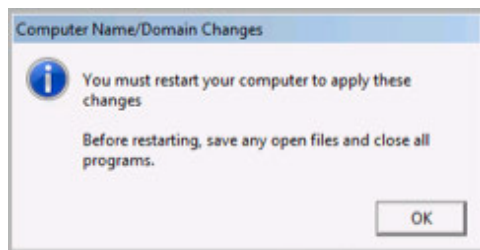
5. A security window pops up, fill in your specific domain administrator credentials and click OK:



6. On successful authentication you will see the following welcome pop-up showing your VM is now on the domain (the domain name should reflect your domain information):



7. Click OK and the VM needs to reboot to complete the process, click OK again and the VM reboots immediately.



## 10.8 ADDITIONAL VIRTUAL MACHINE SETTINGS

1. Perform the following additional tasks on the virtual machine as required:

- OPTIONAL: Upgrade Microsoft Internet Explorer to Version 11 from: <http://windows.microsoft.com/en-us/internet-explorer/download-ie>. Reboot the virtual machine when prompted.



To evaluate browser-based HTML5 applications, consider using newer browsers that utilize hardware acceleration within virtual desktop environments.

- Turn Off Windows Firewall for all network types.





**CAUTION:** THESE INSTRUCTIONS ASSUME THAT THE VM IS BEING USED AS A PROOF-OF-CONCEPT ONLY AND THAT DISABLING THE FIREWALL WILL THEREFORE POSE ONLY A MINIMAL SECURITY BREACH. ALWAYS FOLLOW YOUR ESTABLISHED SECURITY PROCEDURES AND BEST PRACTICES WHEN SETTING UP SECURITY FOR A PRODUCTION MACHINE OR ANY ENVIRONMENT THAT CAN BE ACCESSED FROM OUTSIDE YOUR NETWORK.

2. Shut down the virtual machine once this is completed
3. Close the remote console; this will not be functional when vGPU is configured.

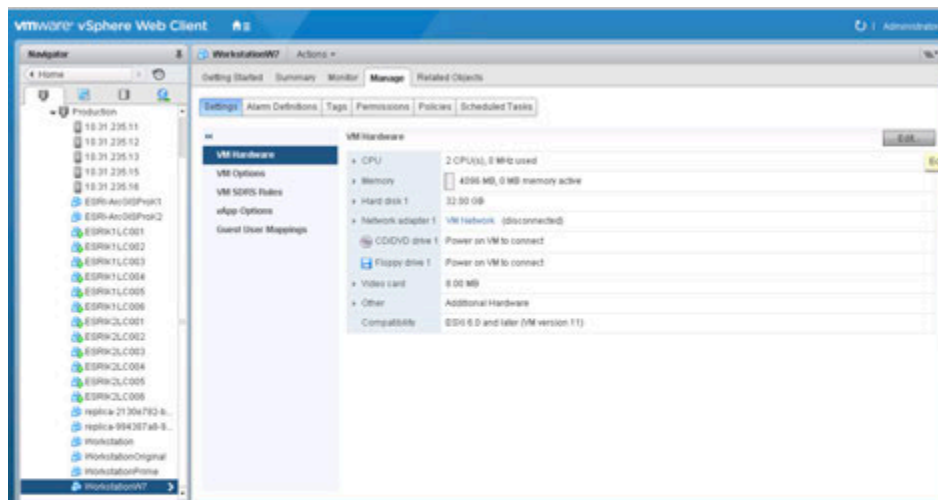


Take a snapshot of the virtual machine to preserve your work. Label this snapshot pre-vGPU, and revert back to it if you encounter any problems going forward, such as driver issues

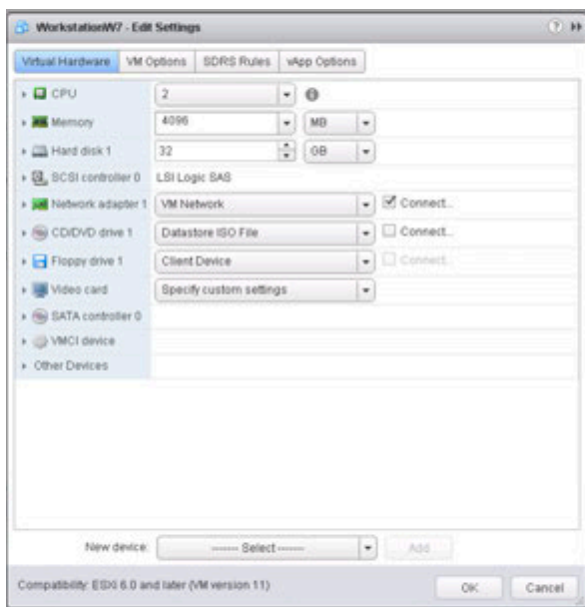
## 10.9 ENABLING THE NVIDIA VGPU

Use the following procedure to enable vGPU support for your virtual machine (you must edit the virtual machine settings):

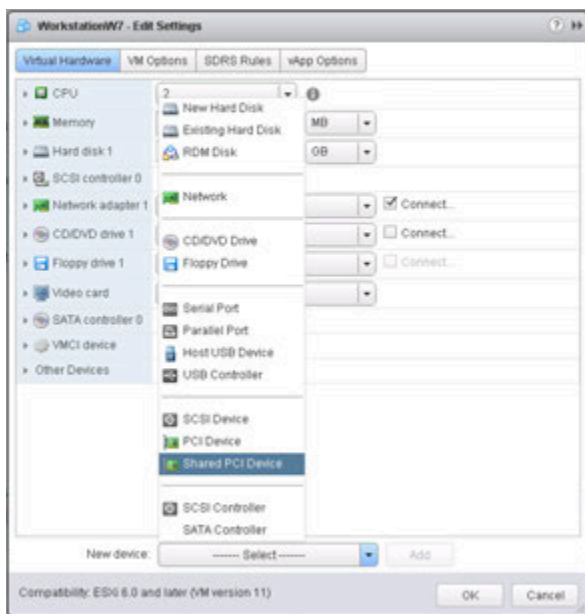
1. Power down the virtual machine.
2. Click on the VM in the Navigator window. Select the Manage tab and settings. Click on the Edit button.



3. The Edit Settings dialog appears.

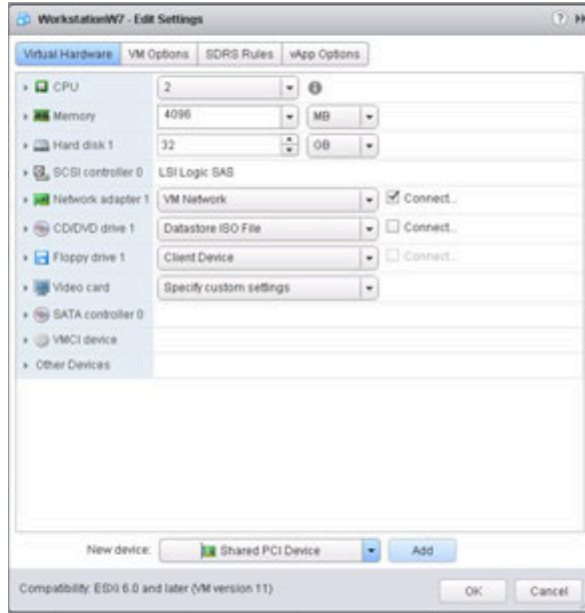


4. Click on the New Device bar and select Shared PCI device.

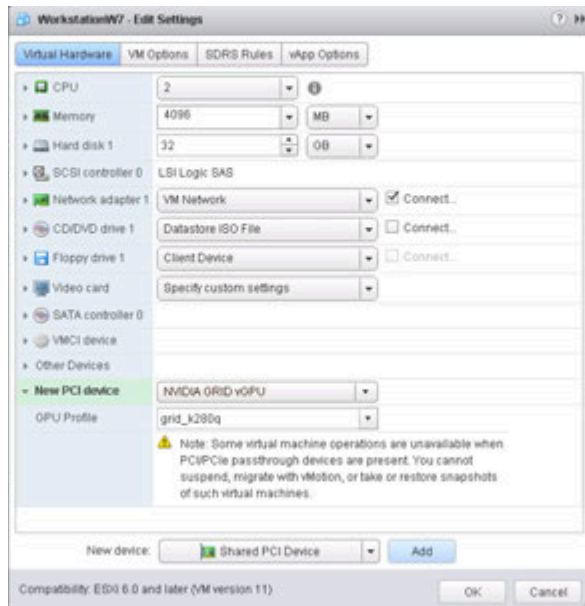


5. Click on Add to continue

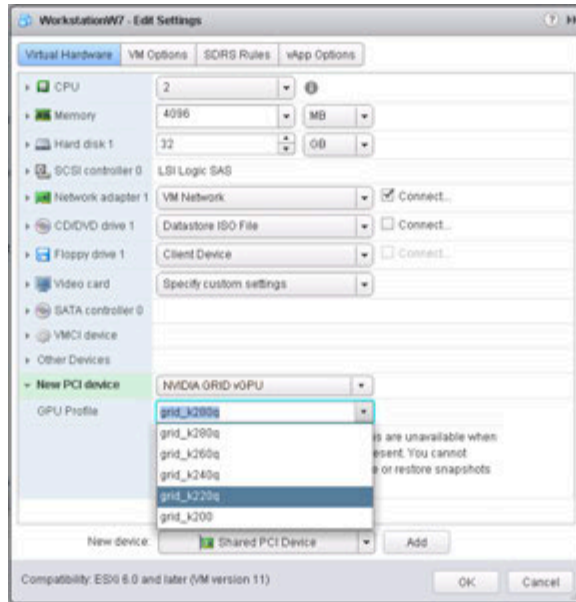




- The new PCI device will show the NVIDIA GRID vGPU device has been added.



- Use the GPU Profile selection bar to configure the GPU.



The k2xx options will appear in servers with K2 GPUs, and the k1xx options will appear in servers with K1 GPUs. The K100 and K200 profiles are not Quadro certified and are being phased out.

8. Click **OK** to complete the configuration.

## 10.10 INSTALLING NVIDIA DRIVER IN WINDOWS VIRTUAL DESKTOP

1. Start the virtual machine, and then connect to it using either VMware Remote Console through the vSphere Web Client or VMware Horizon Client (via Direct Connection).

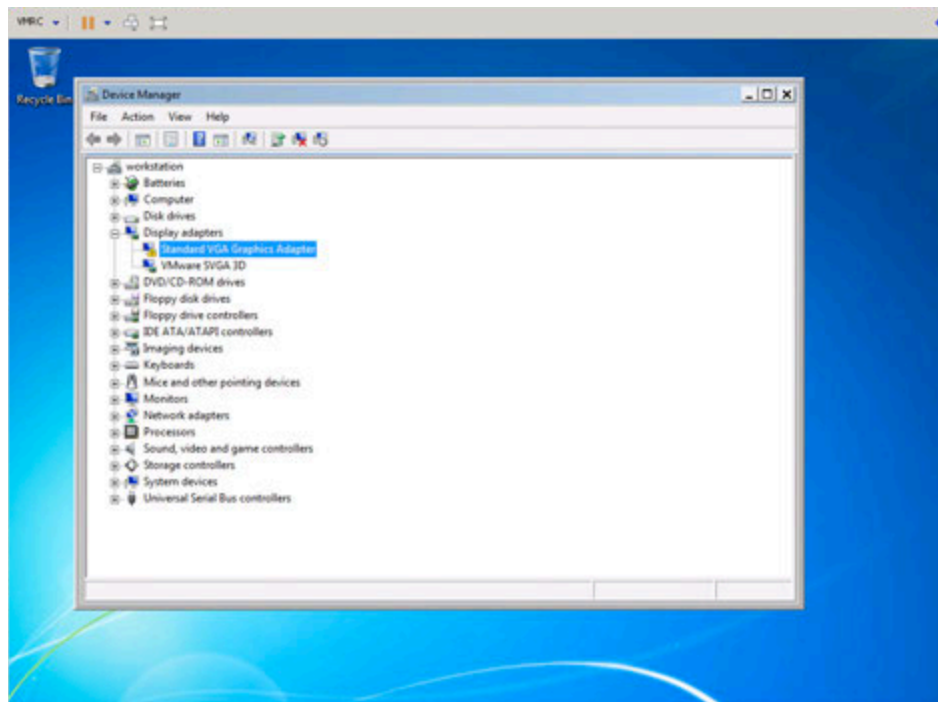
*(When connected, a popup warning requesting that you restart the computer to apply changes will display the first time it is booted after enabling the NVIDIA GRID vGPU.)*

2. Click **Restart Later** to continue booting the virtual machine.

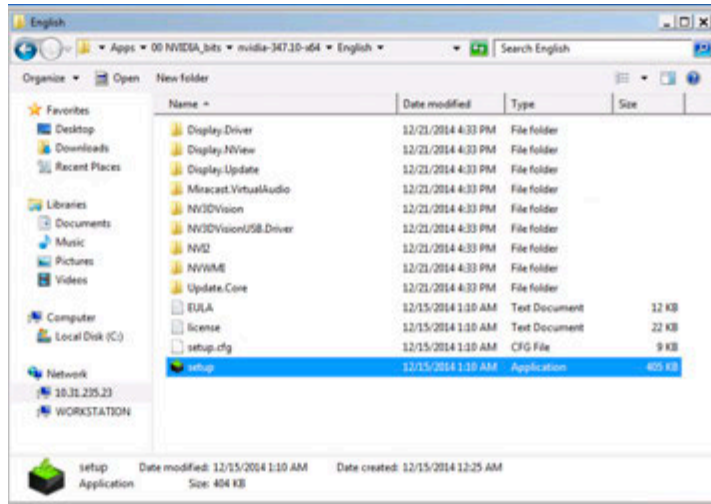


**CAUTION: DO NOT REBOOT THE VIRTUAL MACHINE IF YOU HAVE OLDER NVIDIA DRIVERS INSTALLED. DOING THIS WILL CAUSE A BLUE SCREEN.**

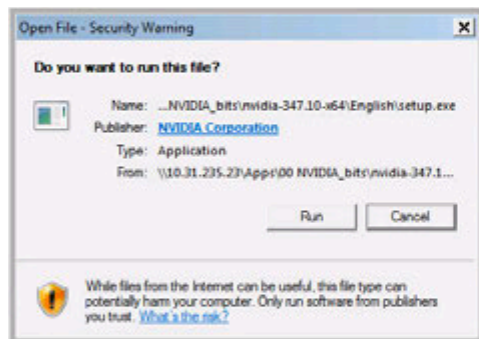
3. Log into Windows and open the Device Manager.  
The **Standard VGA Graphics Adapter** displays in the **Display adapters** section of the Device Manager with an exclamation point by it to indicate a driver problem. This is normal.



4. Locate the NVIDIA driver and double-click the **Setup** icon to launch it.  
(Recommendation: Have the software on a share volume that can be mounted by the VM for quick access.).



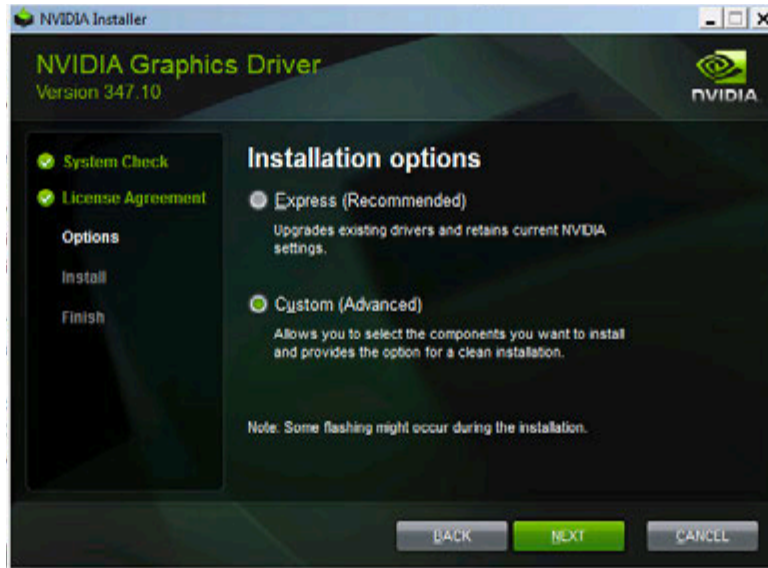
- Accept the Security Warning to continue install.



- The NVIDIA software license agreement window displays. Click the **AGREE AND CONTINUE** button to proceed.



- The **Installation Options** window displays. Check the **Custom (Advanced)** radio button, then click **Next**. The **Custom installation** options window appears.



8. Check the **Perform a clean installation** checkbox, and then click **Next**.



9. A window displays when the NVIDIA Graphics Driver installation is complete.



10. Reboot the VM to complete the install.



After restarting, the mouse cursor may not track properly using VNC or vSphere console. If so, use Horizon Client to Direct Connect.

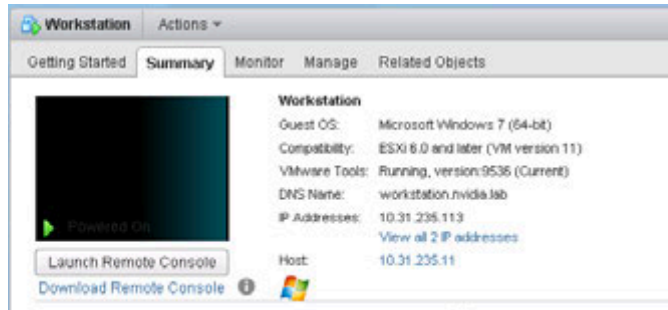
## 10.11 FINALIZING THE INSTALLATION

The final phase of the NVIDIA vGPU configuration is to connect to the virtual machine, verify settings, and then experience the power of fully virtualized GPU support in your favorite testing, benchmarking, multimedia, or 2D/3D/animation applications.

Use the following procedure to finalize the installation.

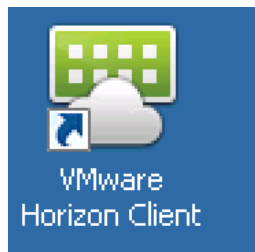
Record in vSphere Web Client, the IP address assigned to the virtual machine by selecting the virtual machine, and then selecting the Summary tab.

1. Select the virtual machine in the **vSphere Web Client** and select the **Summary** tab.
2. Find the IP address assigned to the virtual machine by selecting the VM in the Navigator window and clicking on the Summary tab. The VM's IP Address will appear in the window.

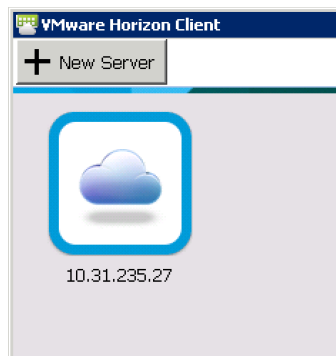


The IP address information will only be displayed if the virtual machine has VMware Tools running and has successfully negotiated an IP address from a DHCP server or when using a static address.

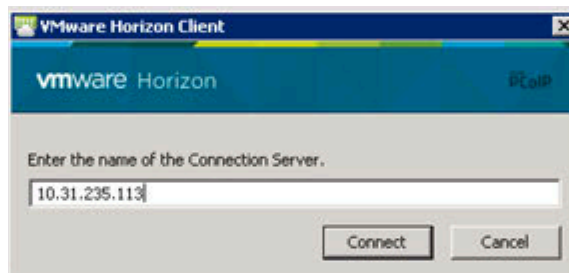
3. Start the **VMware Horizon Client** from the desktop to connect from.



4. Click on **Add Server** to register a new virtual machine connection.

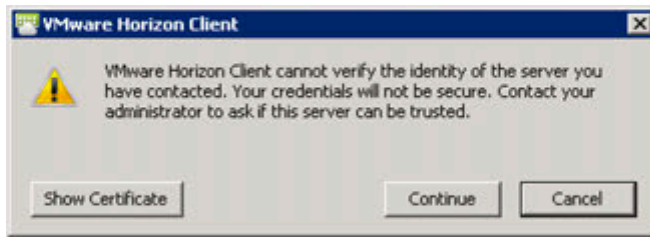


5. Enter the IP address of the VDI desktop to connect to in the **Hostname** field and click **Continue**. *(You are connecting directly to a desktop, don't enter the Horizon View Connection Broker address at this time.)*

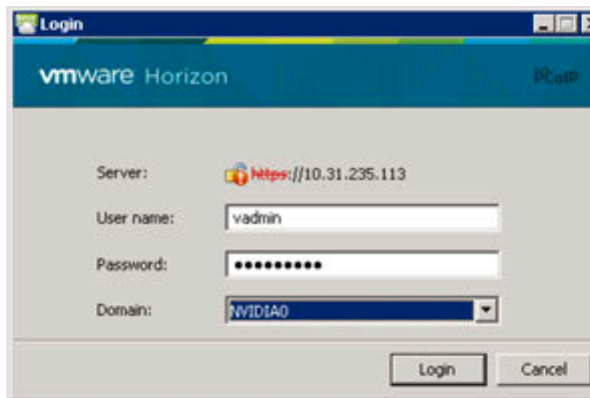




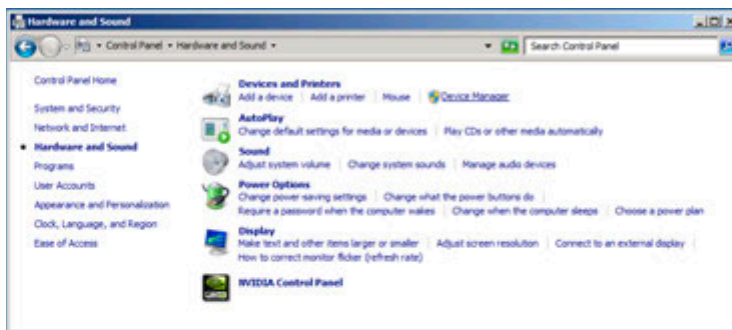
- Click Continue to accept the warning.



- Enter the local user name and password (or the domain user and password if the virtual machine is a domain member) and click **Continue**.

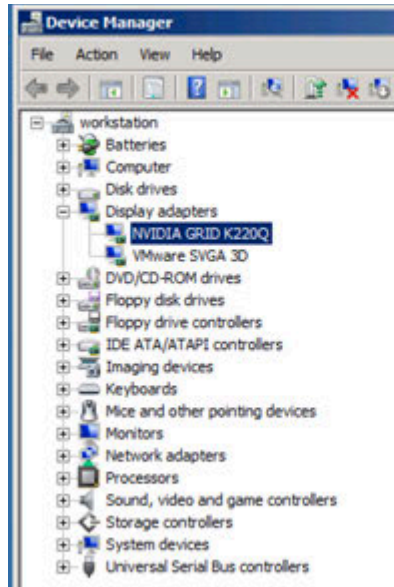


- Log into the virtual machine.
- Open **Device Manager** and confirm that the display adapter is now a vGPU display.

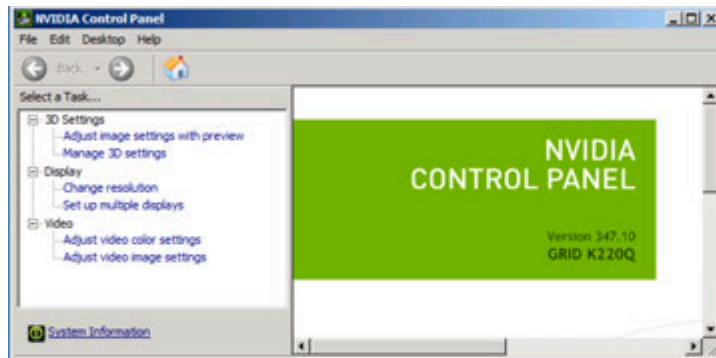


- Open Display adapters in Device Manager:

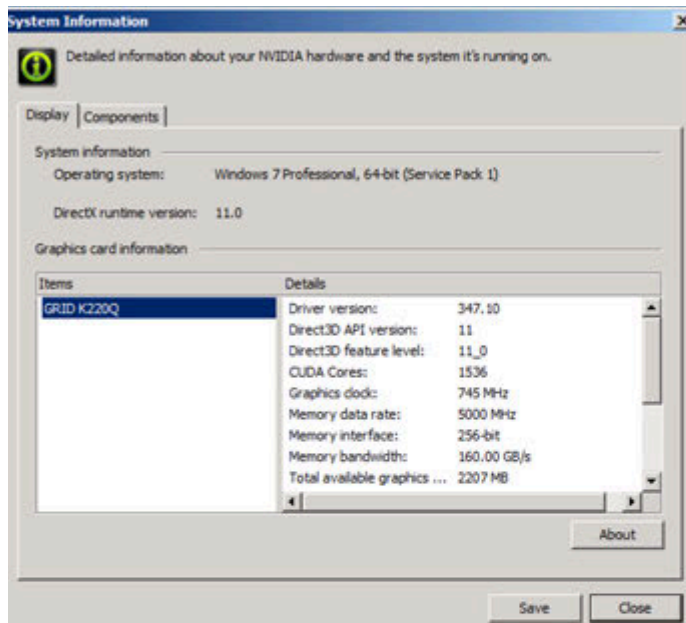




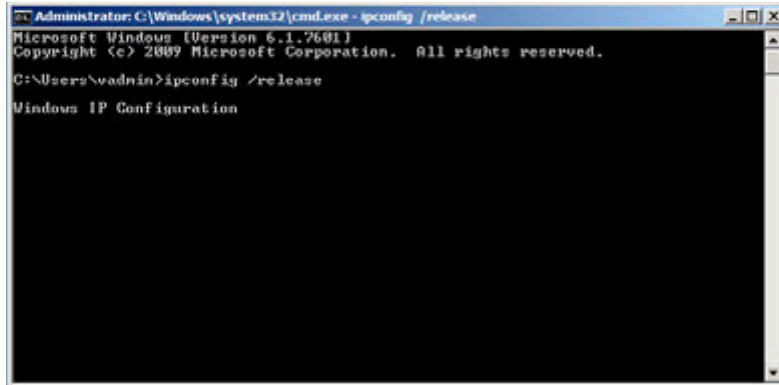
11. Right click the desktop and select **NVIDIA Control Panel**.



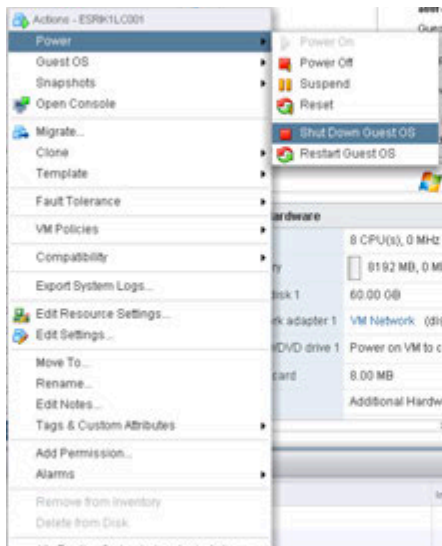
12. Select **System Information** on the bottom left. Confirm the DirectX, graphics card, and driver versions and select **Close** when done.



13. If you plan to use this VM as your master image, release the DHCP address before logging out and shutting down. Open a command prompt and enter: `ipconfig /release`.



14. You will immediately lose connectivity to the VM. Use the vSphere Web Client to shutdown the Guest OS.



A vGPU enabled virtual machine is now confirmed. Next step is to build and deploy a Horizon vGPU Desktop Pool.

# Chapter 11.

## CREATING A HORIZON VGPU POOL

This chapter describes the following:

- ▶ Creating a template from an existing virtual machine.
- ▶ Provisioning a single vGPU-enabled virtual machine from a template
- ▶ Creating a Horizon desktop pool
- ▶ Provisioning vGPU-enabled virtual machines from a template

To create a pool of virtual machines, you must first convert an existing virtual machine into a template, which then allows you to either create a single virtual machine or use it to dynamically create virtual machines on demand.



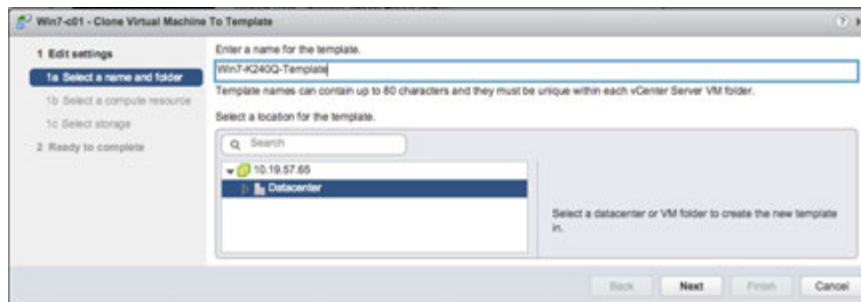
A complete demonstration of these features is beyond the scope of this document; however, converting a virtual machine to a template and then deploying virtual machines from that template is a fundamental operation that can reduce evaluation time.

## 11.1 CREATING A TEMPLATE

Use the following procedure to create a template from an existing virtual machine:

1. Right-click a virtual machine and then select **Clone** → **Clone to Template...**

The **Clone Virtual Machine To Template** popup displays with the **Select a name and folder** tab selected.



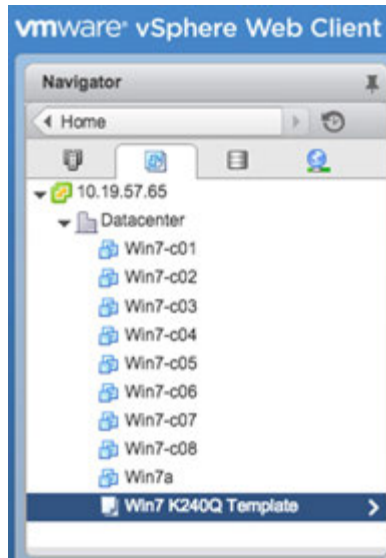
2. Enter a name for the template
3. Select either a datacenter or virtual machine folder to create the template
4. Select **Next** to display the **Select a compute resource** tab.
5. Select the host or cluster to store the template
6. Select **Next** to display the **Select storage** tab.
7. Select the storage type and target data store.
8. Select **Next** to display the **Ready to complete** tab.
9. Review the settings and click **Finish** to start cloning the virtual machine to a template.



The vSphere Web Client **Recent Tasks** view displays the progress of the cloning operation.



Upon completion, the template displays within the target datacenter and/or host.

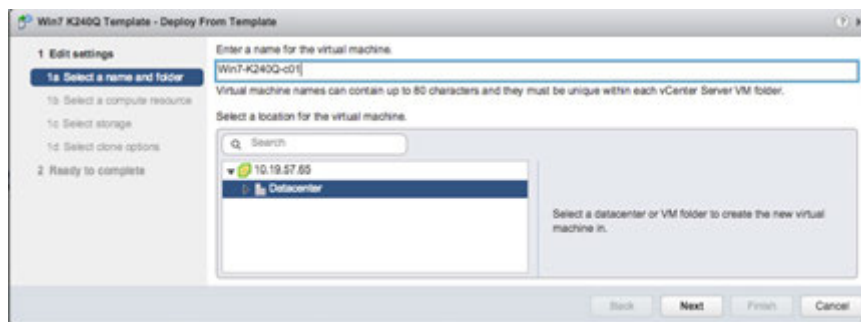


## 11.2 PROVISIONING A SINGLE VIRTUAL MACHINE

Use the following procedure to provision a single vGPU-enabled virtual machine from a template:

1. Right-click the template and select **Deploy from this Template...**

The **Deploy From Template** window displays with the **Select a name and folder** tab selected.



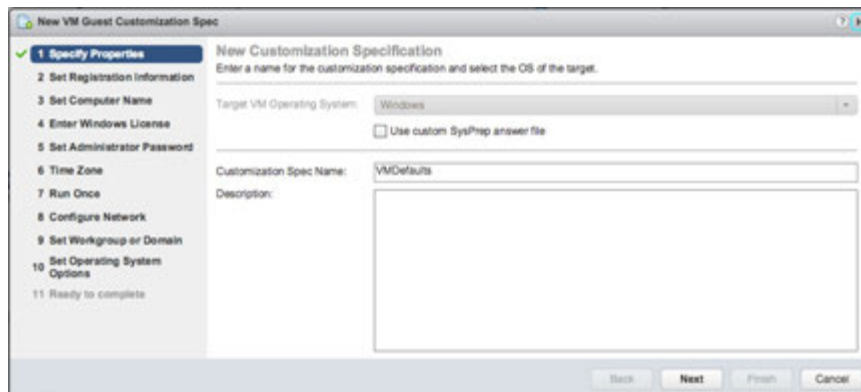
2. Enter a name for the new virtual machine.
3. Select **Next** to display the **Select a compute resource** tab.
4. Select the cluster or host
5. Select **Next** to display the **Select storage** tab.
6. Select the target storage type and data store.

7. Select **Next** to display the **Select clone options** tab.



8. Check the **Customize the operating system** checkbox.
9. Select **Next** to display the **Customize guest OS** tab.
10. Select the **Create a new specification** (folder with a plus sign) icon.

The New Customization Specification window displays with the Specify Properties tab selected.



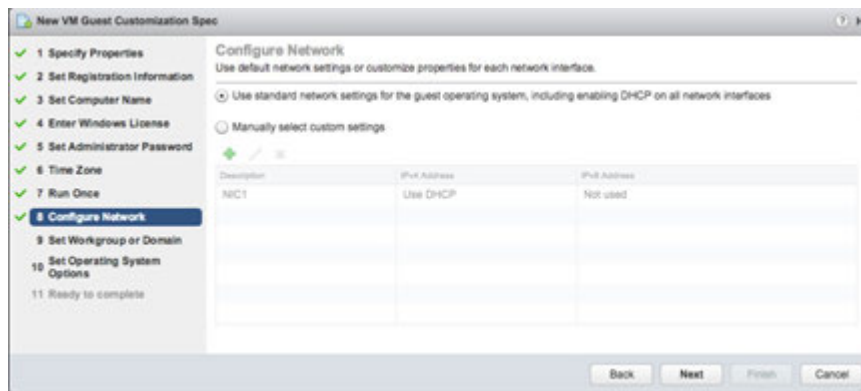
11. Proceed as follows:

- If your organization currently utilizes an answer file, then you can load that file by checking the **Use custom SysPrep answer file** checkbox.
- If your organization does not use this functionality, then leave the **Use custom SysPrep answer file** checkbox cleared; enter a name for the new specification in the **Customization Spec Name** field, and click **Next** to proceed.

The **Set Registration Information** tab displays.

12. Enter the user and organization names in the **Name** and **Organization** fields, respectively.
13. Select **Next** to display the **Set Computer Name** tab.
14. Enter a computer name.
15. Check the **Append a numeric value to ensure uniqueness** checkbox,
16. Select **Next** to display the **Enter Windows License** tab.

17. Enter your Windows product key information or leave this field blank
18. Select **Next** to display **Set Administrator Password**.
19. Enter and confirm the administrator password (case sensitive) in the **Password** and **Confirm Password** fields,
20. Select **Next** to display the **Time Zone** tab.
21. Use the **Time Zone** pull-down menu to select your time zone.
22. Select **Next** to display the **Run Once** tab.
23. Enter any one-time commands in this tab if needed.
24. Select **Next** to display the Configure Network Tab.



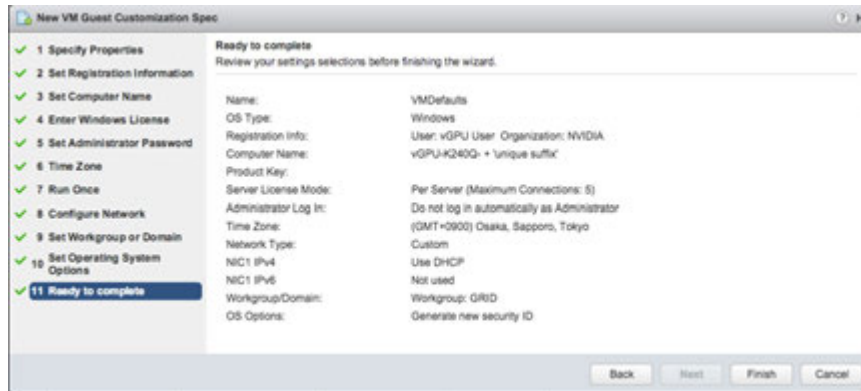
25. Check the appropriate radio button to either:
  - **Use standard network settings...**  
This option automatically selects network settings
  - **Use manual network settings**  
For this option you enter the network description, IPv4 address, and/or IPv6 address in the respective fields.
26. Click **Next** to display the **Set Workgroup or Domain** tab.




27. Check the appropriate radio button to select either a workgroup or domain.



28. Enter the information workgroup or domain for the virtual machine to join in the appropriate fields
29. Select **Next** to display the **Set Operating System Options** tab.
30. Check the **Generate New Security ID (SID)** checkbox.
31. Select **Next** to display the **Ready to complete** tab.



32. Review your settings.
33. Select **Finish** to view the new customization specification from the template.

 You do not need to create a new virtual machine guest customization specification every time you clone a virtual machine from a template.

The **Ready to complete** tab of the **Deploy From Template** window displays with the new customization specification listed.



34. Review the settings and select **Finish** to begin creating the virtual machine from the template.

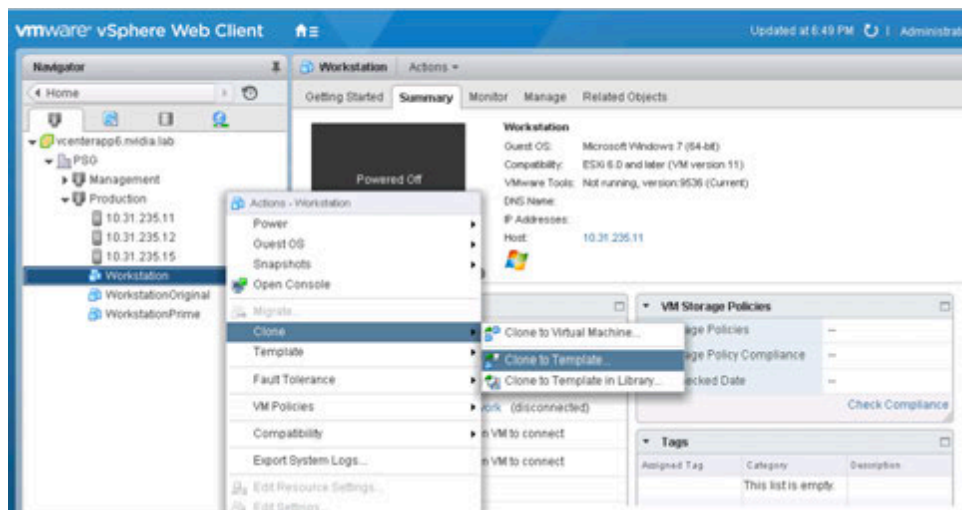
The cloned virtual machine is now visible in the datacenter and on the host that it was cloned to. Adding the new virtual machine to a Horizon View Desktop Pool and then entitling users and/or groups is performed as described in section 11.5, Entitling Users access to Desktop Pools, page 195.

Horizon View can leverage templates to automatically create virtual machines on demand for time and resource saving functionality. Refer to the *Horizon View* documentation for instructions on using this functionality.

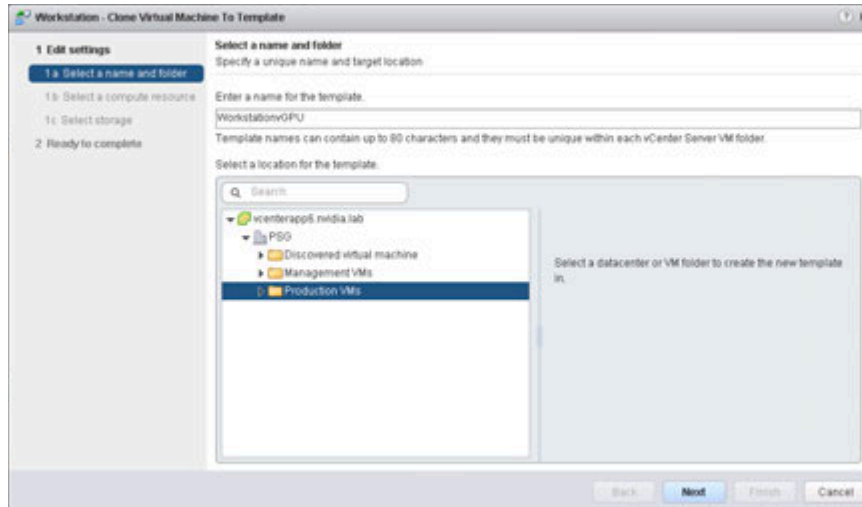
The next sections describe how to install desktop pools and then grant entitlements to users and groups to use that pool. Desktop pools can be created from a Master Image with either Full Clones or with Linked Clones with the help of Horizon View Composer. In the following sections both use cases will be explained

## 11.3 CREATING FULL CLONE DESKTOP POOLS

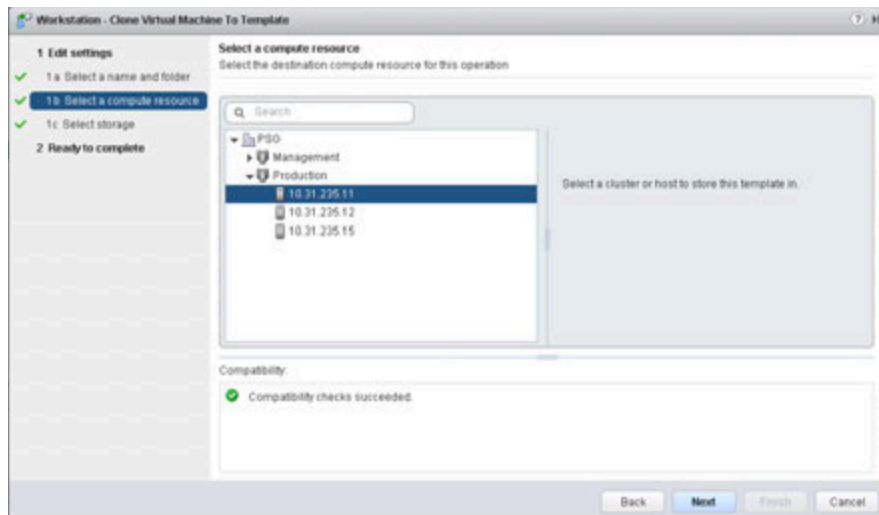
1. Full clone desktop pools require a Template of the Master image. Select the reference VM in the Navigator and right click. Select Clone, Clone to Template. (*A template can also be created by Converting a VM to a Template use the Template option.*)



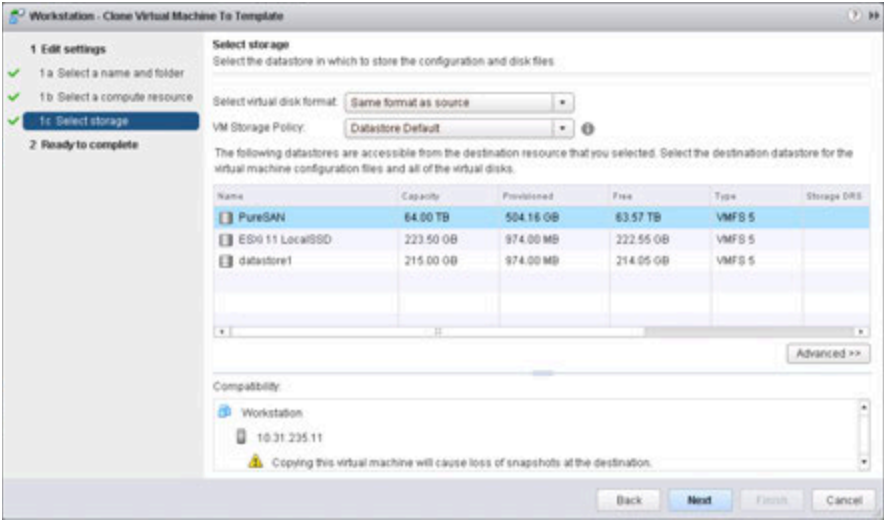
2. The Clone Virtual Machine to Template wizard walks you through the steps. Name the Template and Select a Location for the Template.



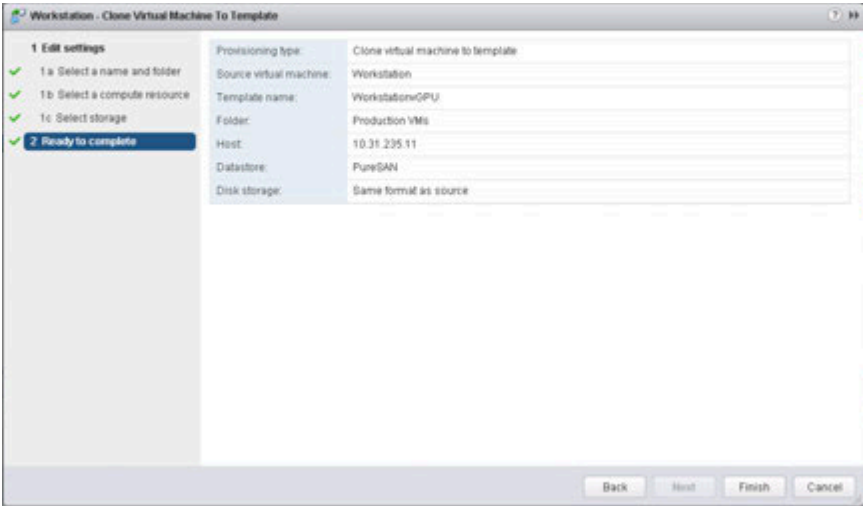
3. Select a Compute Resource to place the Template.



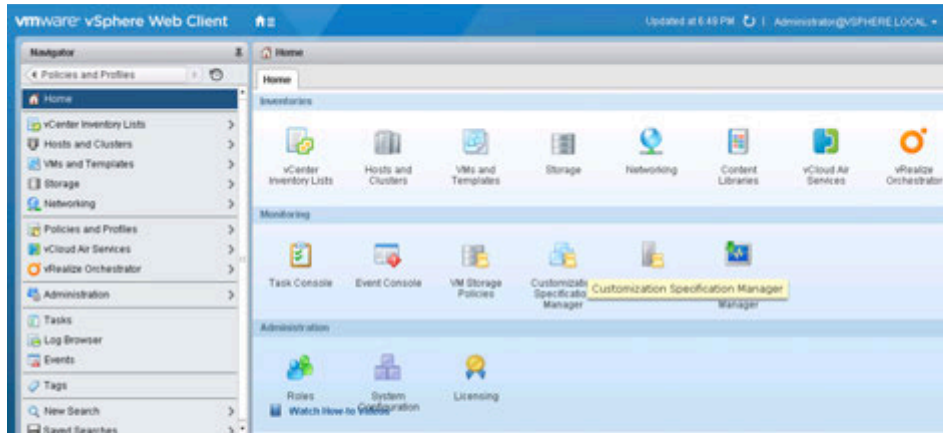
4. Select the Storage location for the Template.



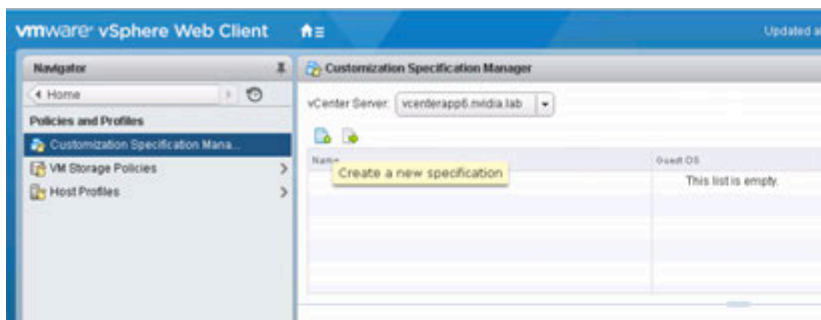
5. Review the Clone to Template settings. Click Finish to create the Template.



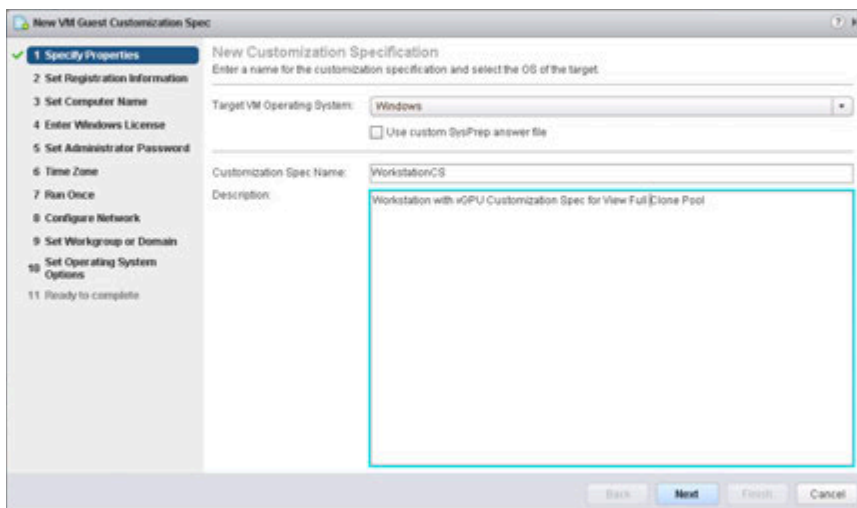
6. Create a Customization Specification file to deploy full clone pool.



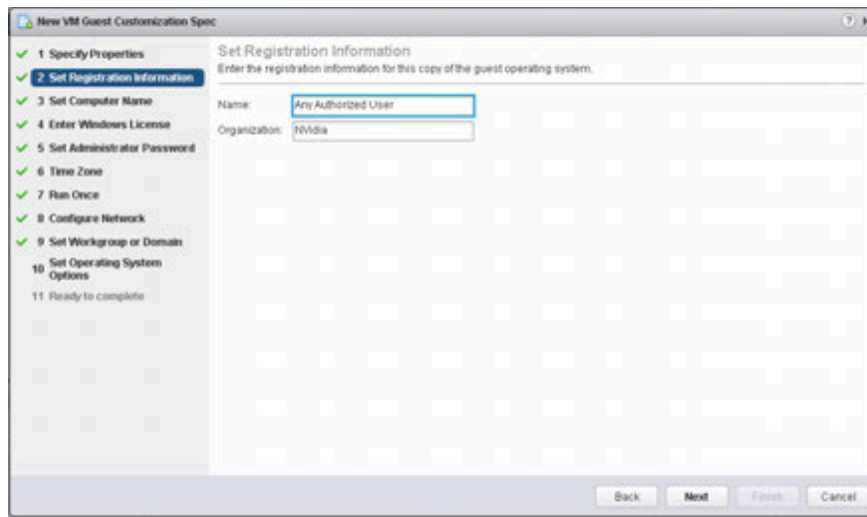
7. Select Create a new specification



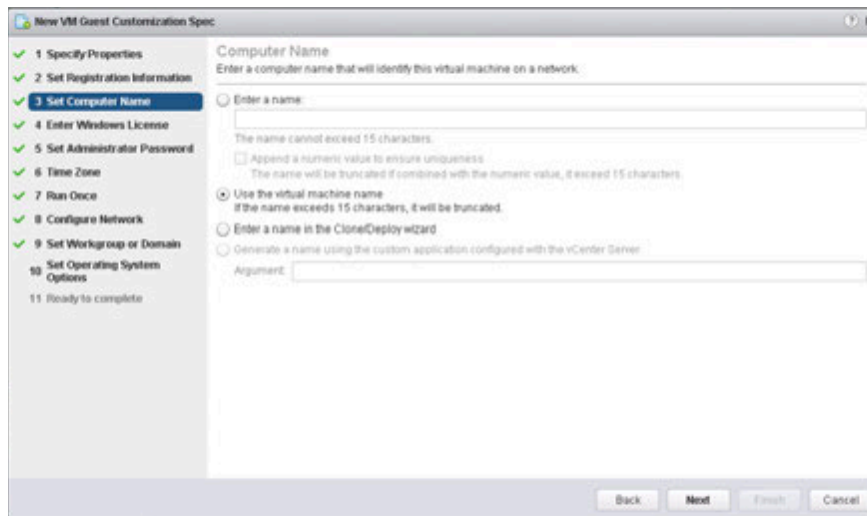
8. The New VM Guest Customization Spec Wizard appears, enter your customization spec name and description and click **Next**



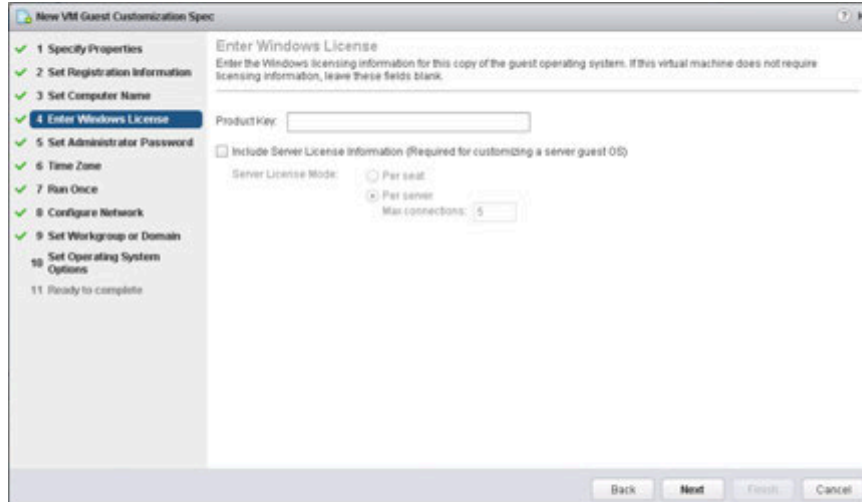
9. Enter the Name and Organization to Set the Registration Information and click **Next**



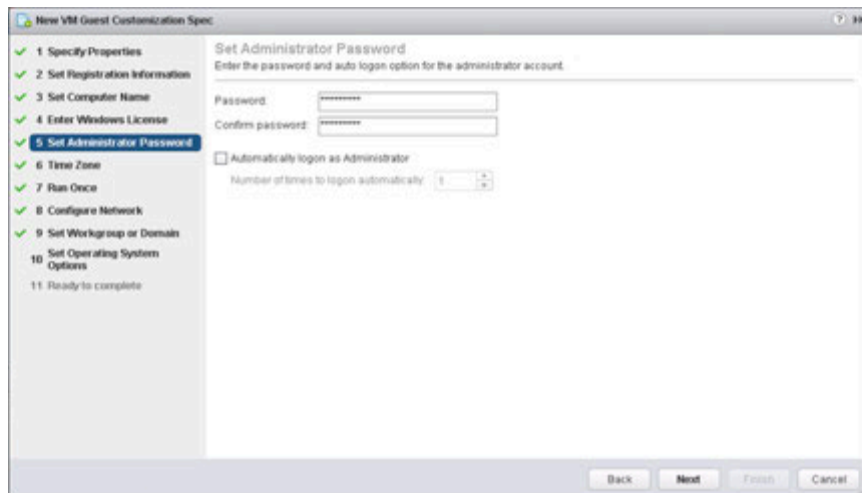
10. Set the Computer Name options and click **Next**



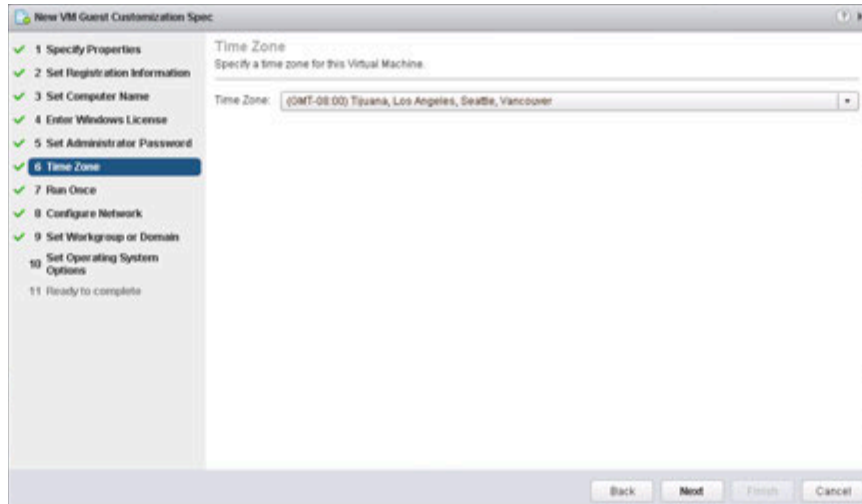
11. Enter the Windows product key, choose options, and click **Next**



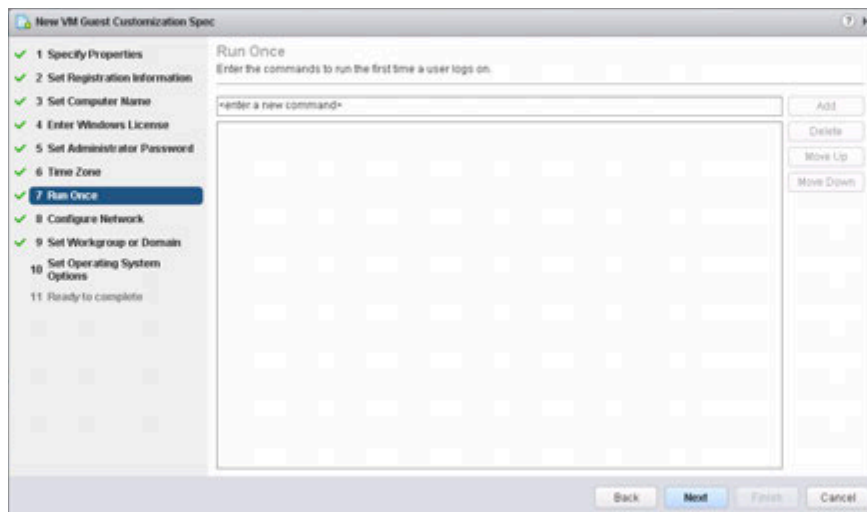
12. Set the Administrator Password and click **Next**



13. Set the default time zone for your template and click **Next**

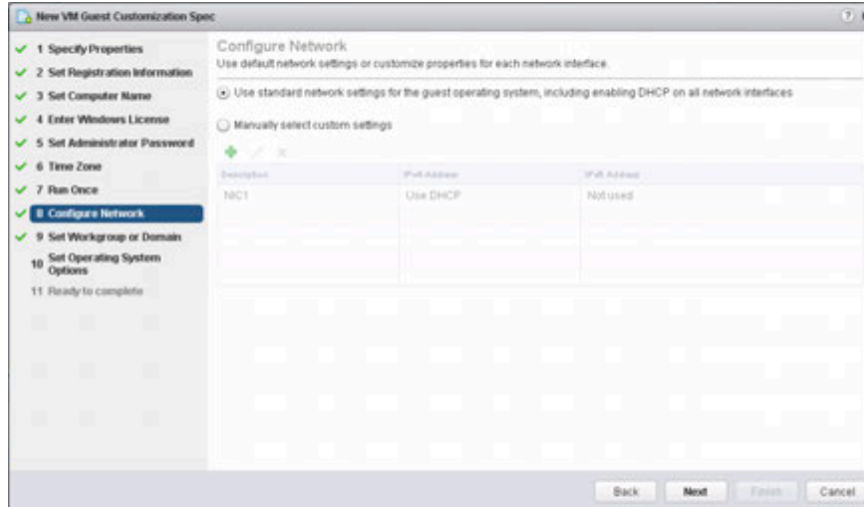


14. Set any Run Once policies on first book and click **Next**

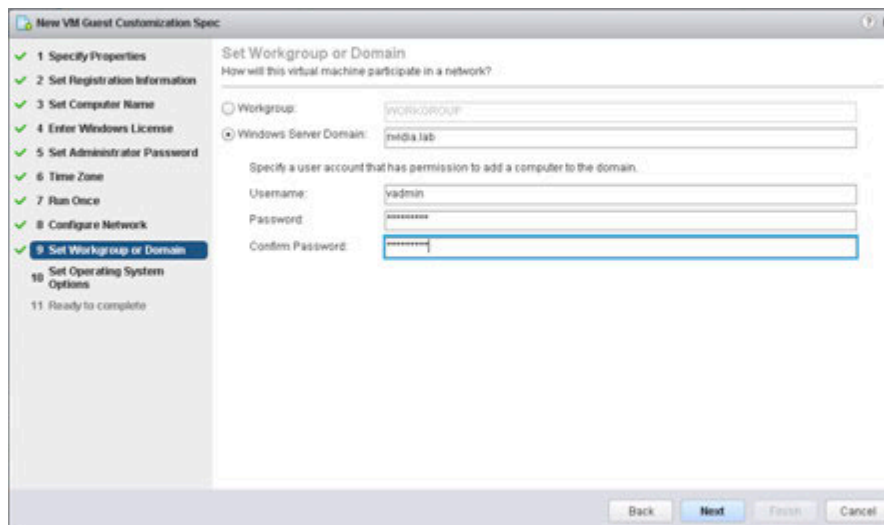


15. Set your default network configuration and click **Next**

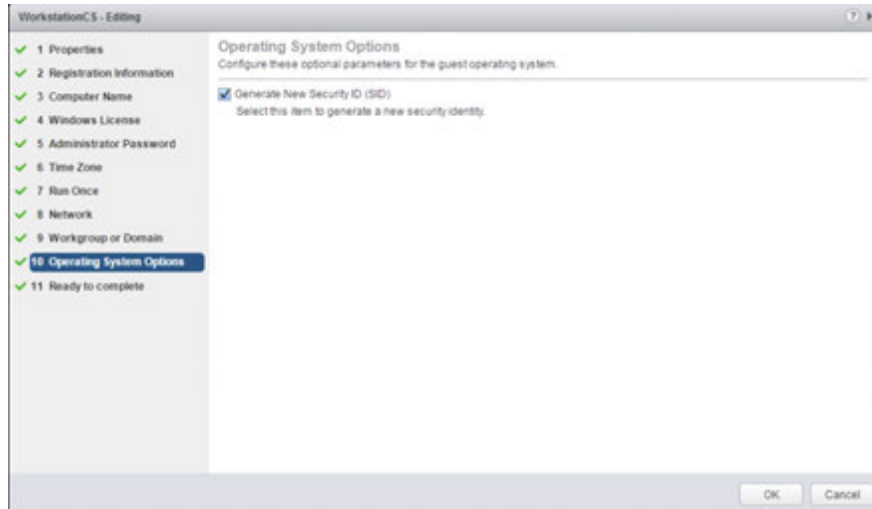




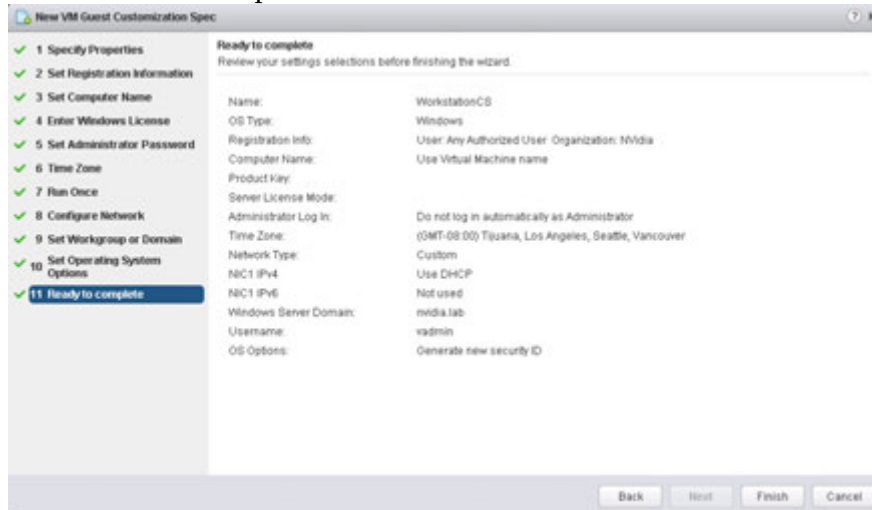
16. Set the Workgroup or Domain for your virtual machines and click **Next**



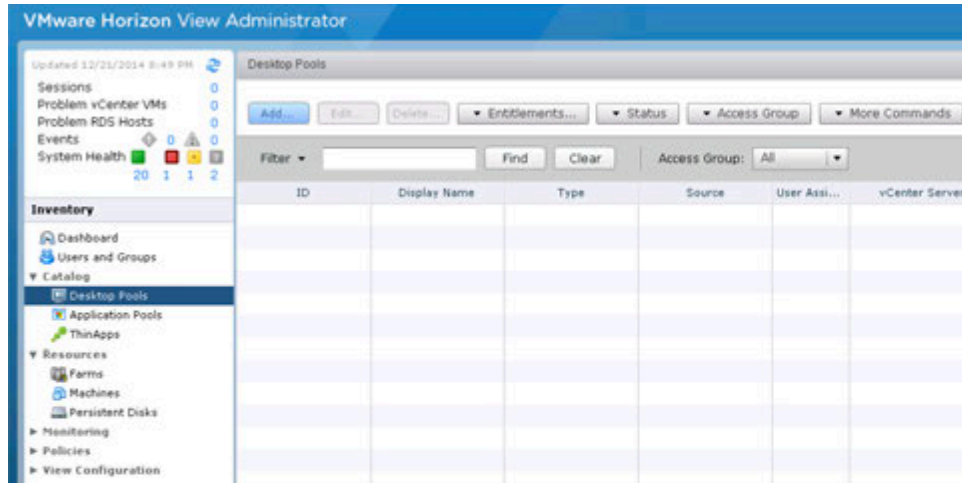
17. Select **Generate New Security ID (SID)**, and click **OK**.



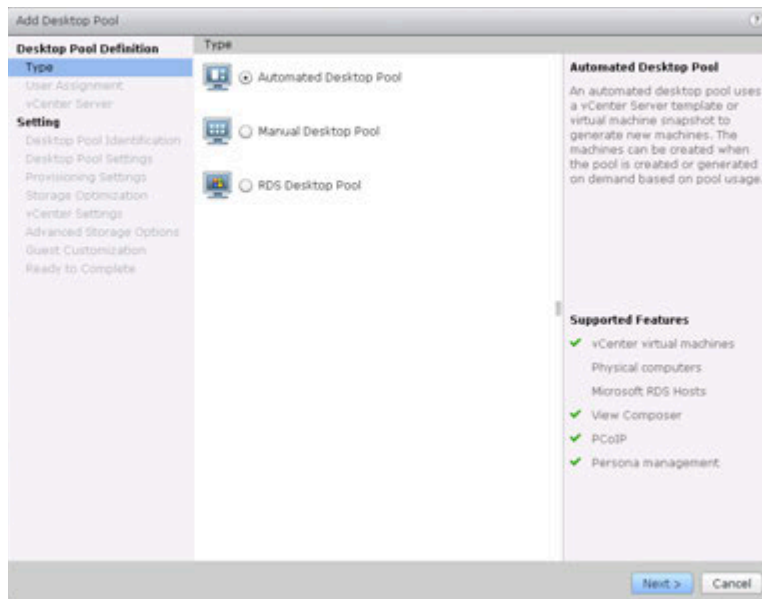
18. Click Finish to complete.



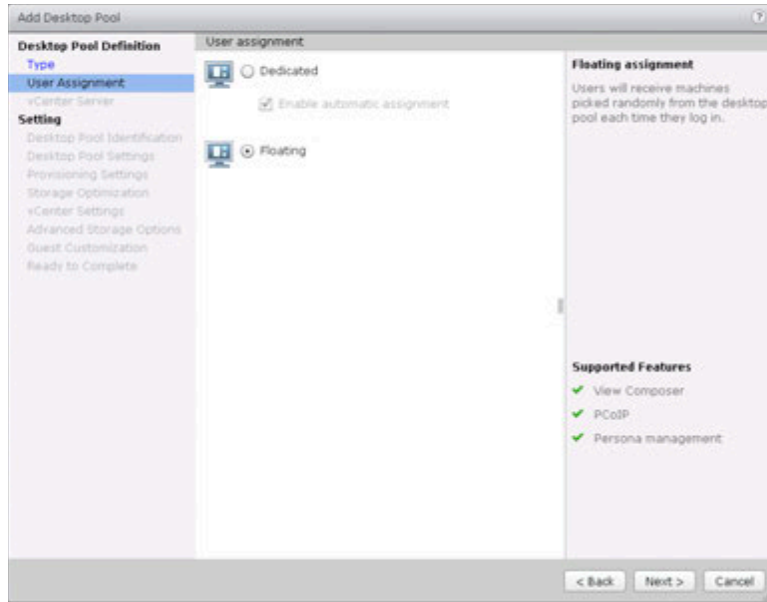
19. Login to the Horizon View Manager. Select Desktop Pools in the Inventory window and Click on Add...



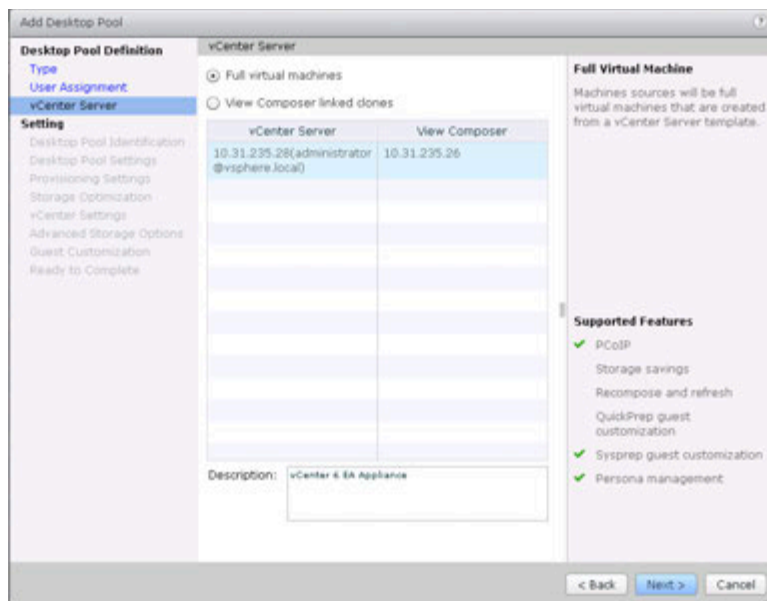
20. Select Automated Pool, and click Next.



21. Select Floating User Assignment, and click Next.



22. Select Full Virtual Machines, and click Next.



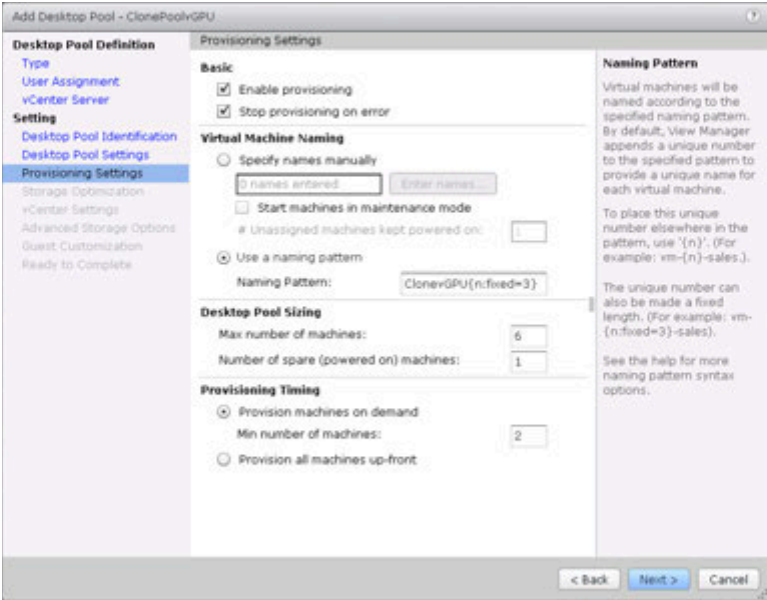
23. Name the Desktop Pool, and click Next.

The screenshot shows the 'Add Desktop Pool - ClonePoolvGPU' wizard, specifically the 'Desktop Pool Identification' step. The left sidebar lists the steps: Desktop Pool Definition, Type, User Assignment, vCenter Server, and Setting. Under 'Setting', the sub-steps are Desktop Pool Identification (selected), Desktop Pool Settings, Provisioning Settings, Storage Optimization, vCenter Settings, Advanced Storage Options, Guest Customization, and Ready to Complete. The main area is divided into three sections: ID, Display Name, and Access Group. The ID field contains 'ClonePoolvGPU'. The Display Name field also contains 'ClonePoolvGPU'. The Access Group dropdown is set to '/'. A Description field is empty. On the right, there are informational text blocks for ID, Display Name, Access Group, and Description. At the bottom, there are '< Back', 'Next >', and 'Cancel' buttons.

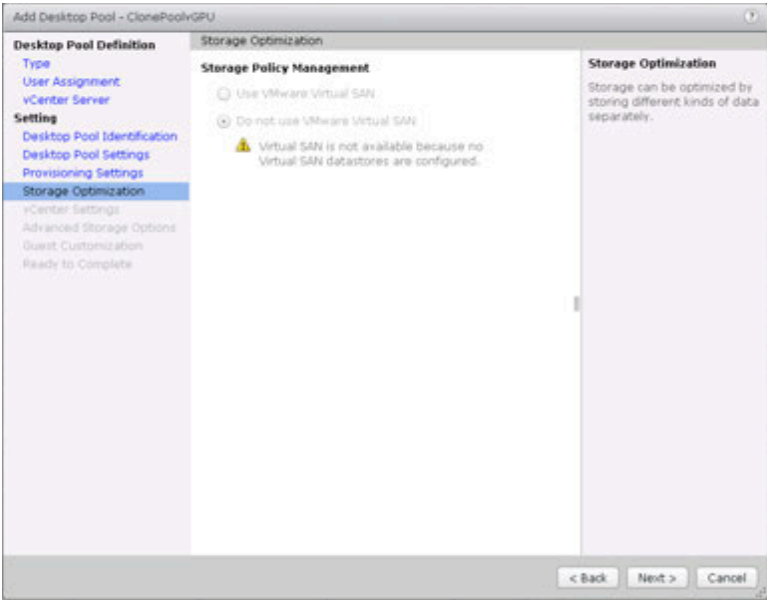
24. In Desktop Pool Settings, Set Default display protocol to **PCoIP**, allow users to decide to **No**, and 3D Renderer to **NVIDIA GRID VGPU**. (*HTML access is supported in this version if it is desired.*)

The screenshot shows the 'Add Desktop Pool - ClonePoolvGPU' wizard, specifically the 'Desktop Pool Settings' step. The left sidebar is the same as the previous screenshot, but 'Desktop Pool Settings' is now selected. The main area contains several settings sections: 'separate sessions from different client devices' with a 'Delete machine after logoff' dropdown set to 'No'; 'Remote Display Protocol' with 'Default display protocol' set to 'PCoIP', 'Allow users to choose protocol' set to 'No', and '3D Renderer' set to 'NVIDIA GRID VGPU' with a 'Configure...' button; 'Max number of monitors' set to '2'; 'Max resolution of any one monitor' set to '1920x1200'; 'HTML Access' with an 'Enabled' checkbox; 'Adobe Flash Settings for Sessions' with 'Adobe Flash quality' set to 'Do not control' and 'Adobe Flash throttling' set to 'Disabled'; and 'Mirage Settings' with an 'Override global Mirage settings' checkbox and a 'Mirage Server configuration' field. At the bottom, there are '< Back', 'Next >', and 'Cancel' buttons.

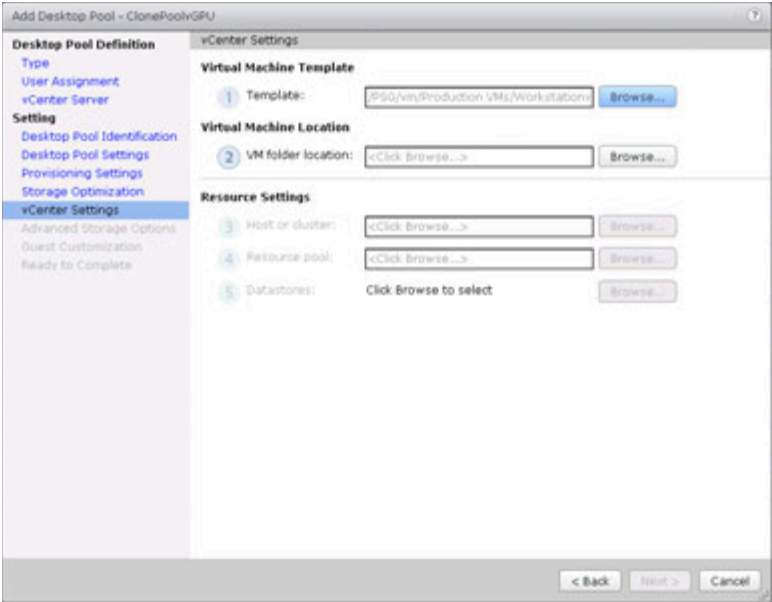
25. In Provisioning Settings, Click on **Select a naming pattern**, enter a naming pattern that will help differentiate the VMs in this pool from other pools you create. Choose **Desktop Pools Sizing** and **Provisioning Timing** to values that make sense for your infrastructure.



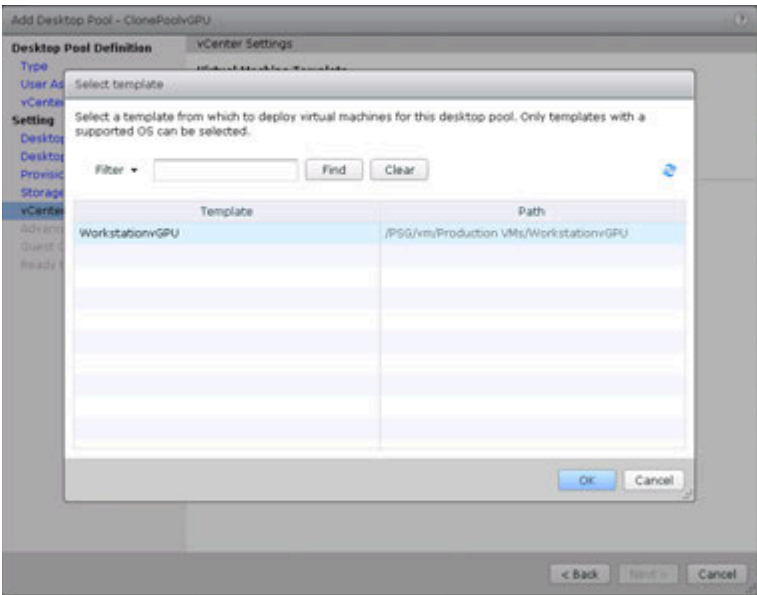
26. Storage Policy Management options available when Virtual SAN is configured.



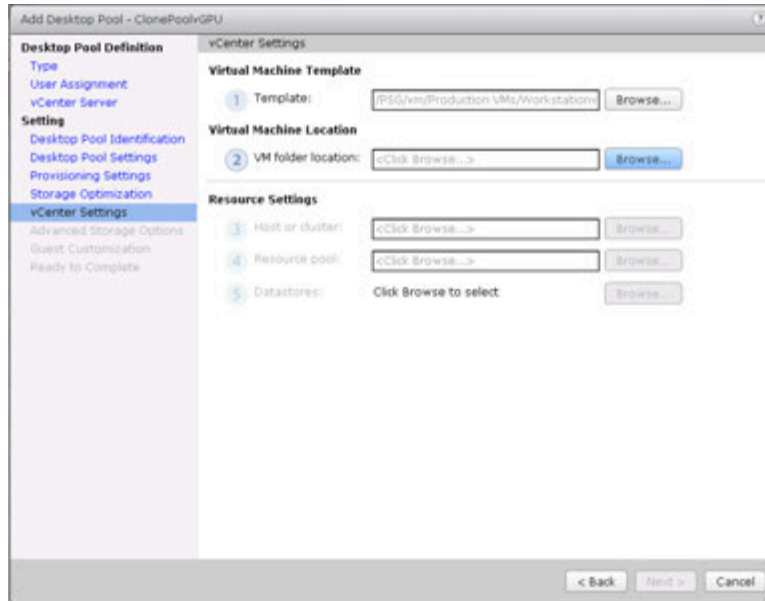
27. Select Browse to locate Template file.



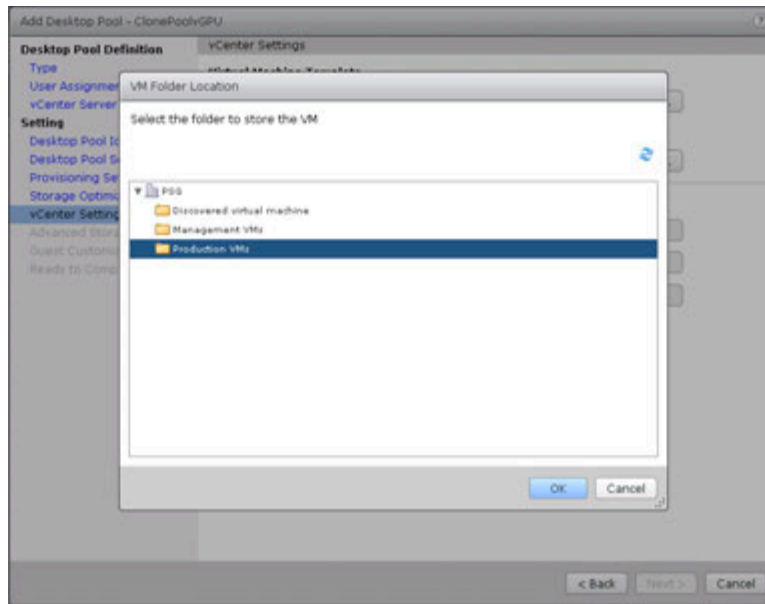
28. Select the Template created earlier for the Master Image. Click Next to continue.



29. Click Browse to select the VM folder location. Click Next to continue.

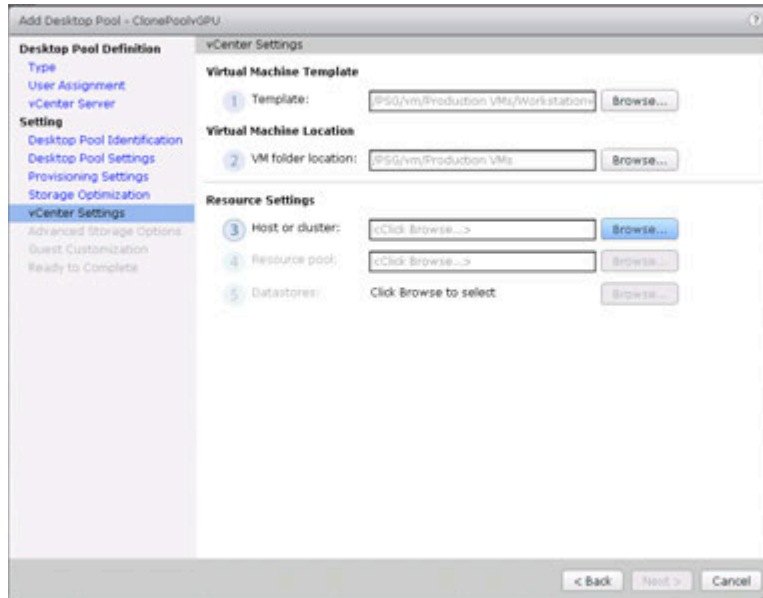


30. Select a folder to store the VMs

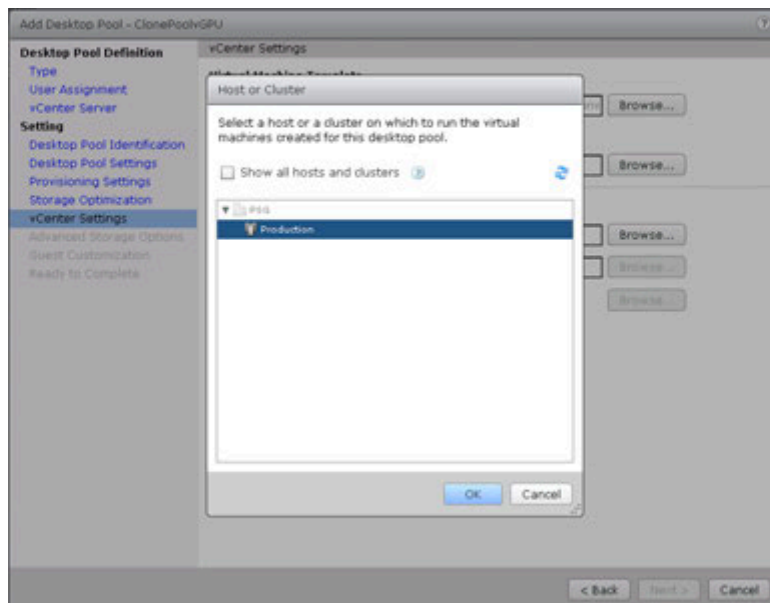


31. Click **Browse** to select the appropriate Host or Cluster.

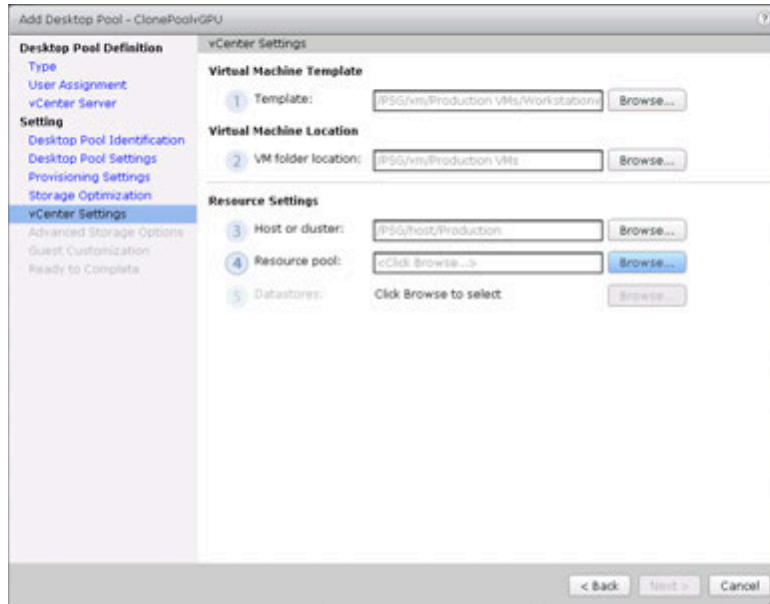




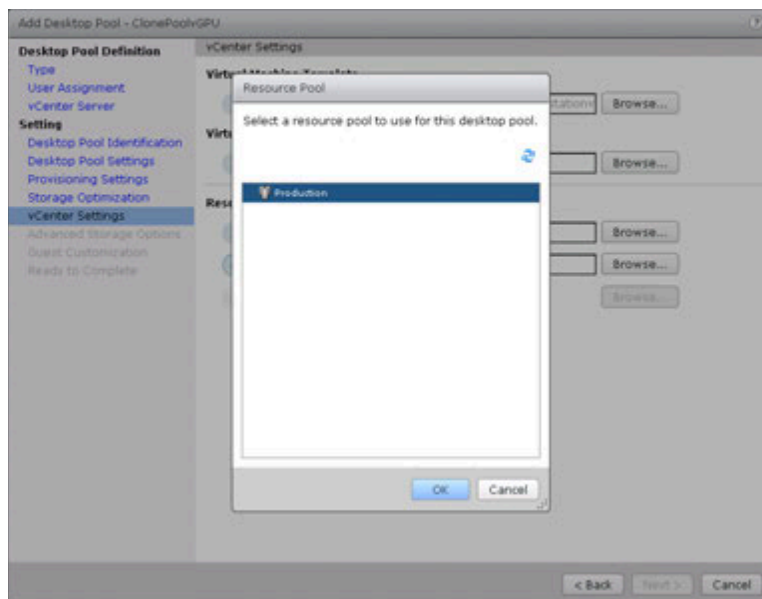
32. Select a Host or Cluster. Select the VGPU cluster created earlier, and click OK.



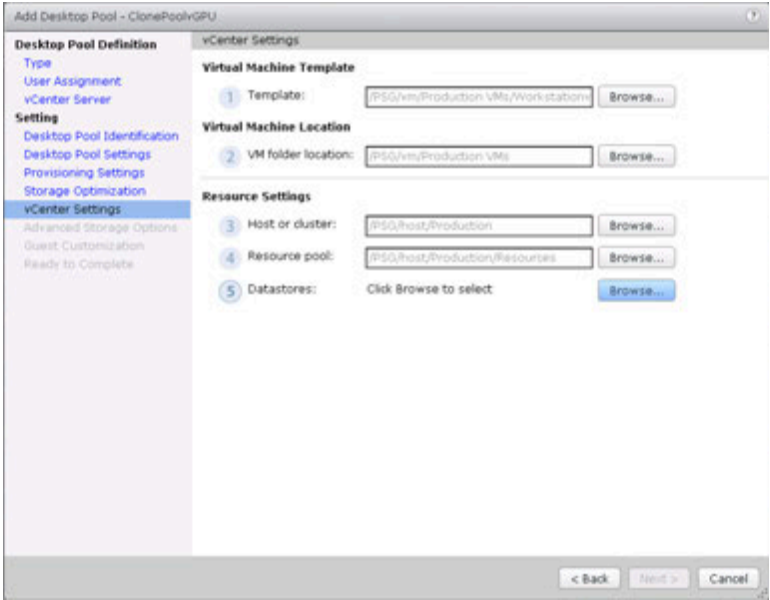
33. Click **Browse** to select a Resource Pool.



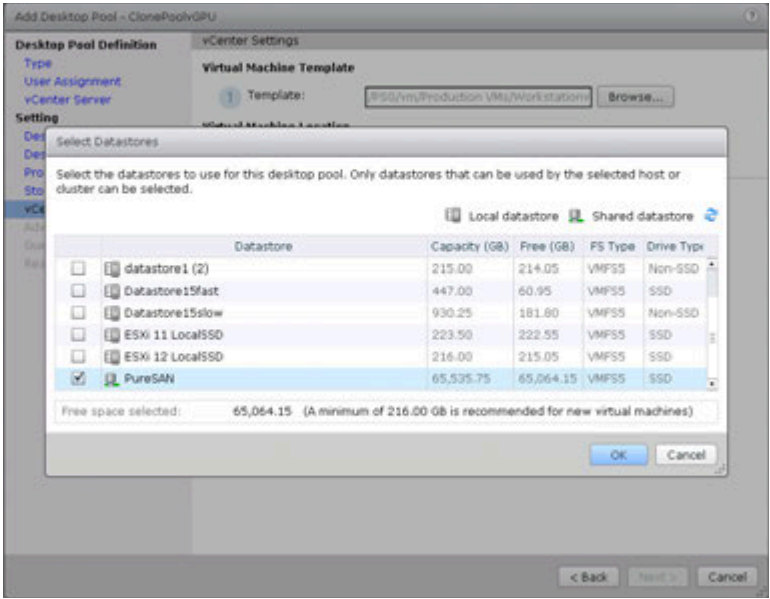
34. Select a Resource Pool, and click OK.



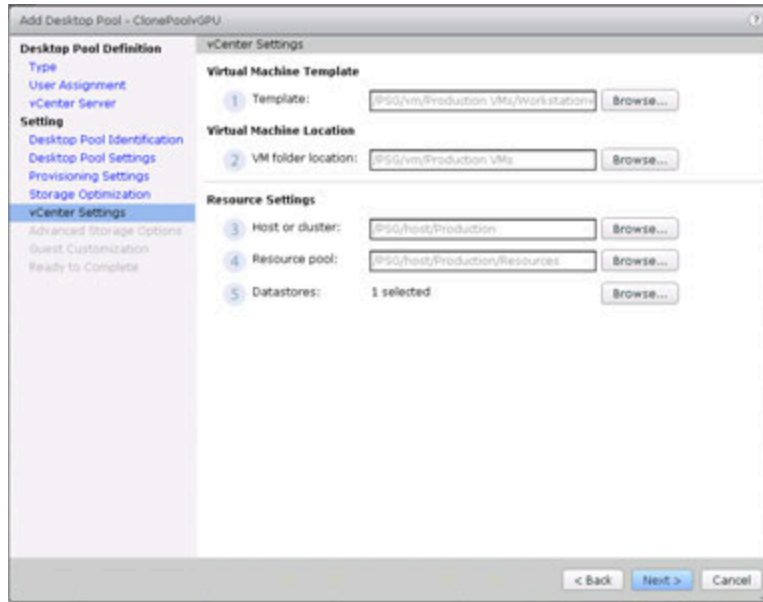
35. Click **Browse** to select a Datastore for the Desktop Pool.



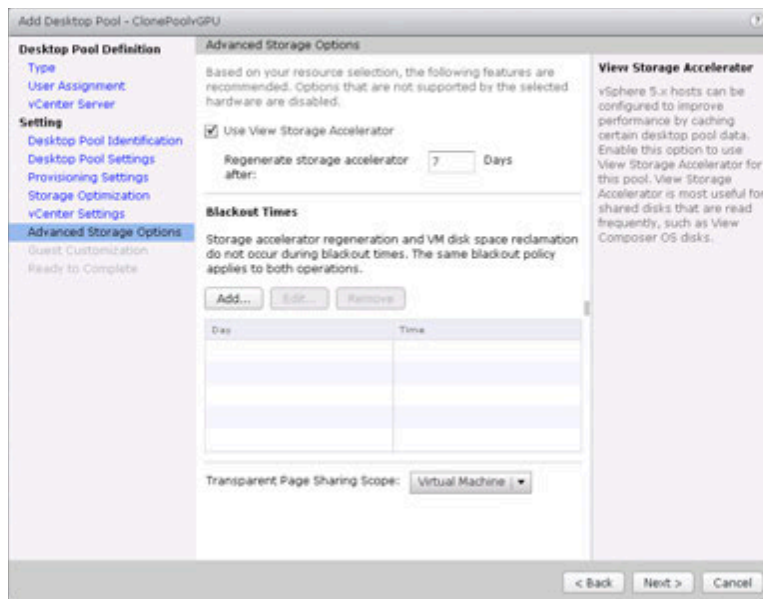
36. Select Datastores, and click OK.



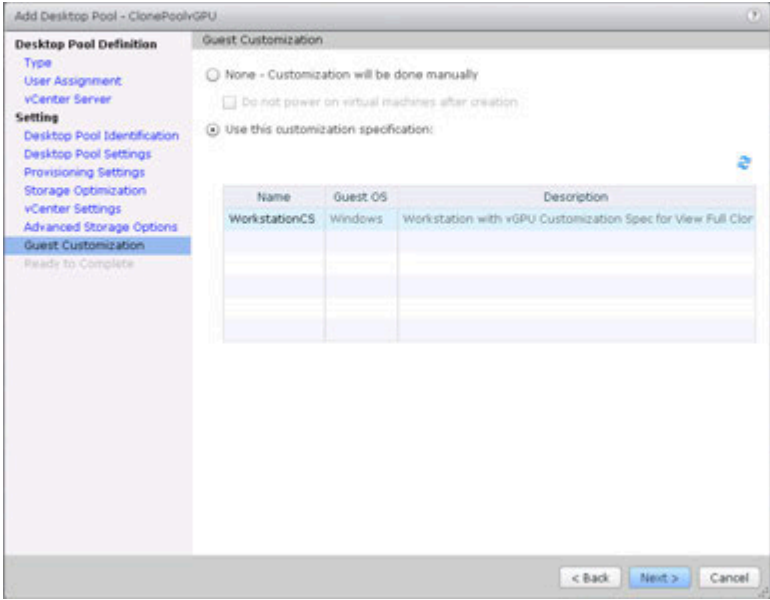
37. Review Settings and click Next to continue.



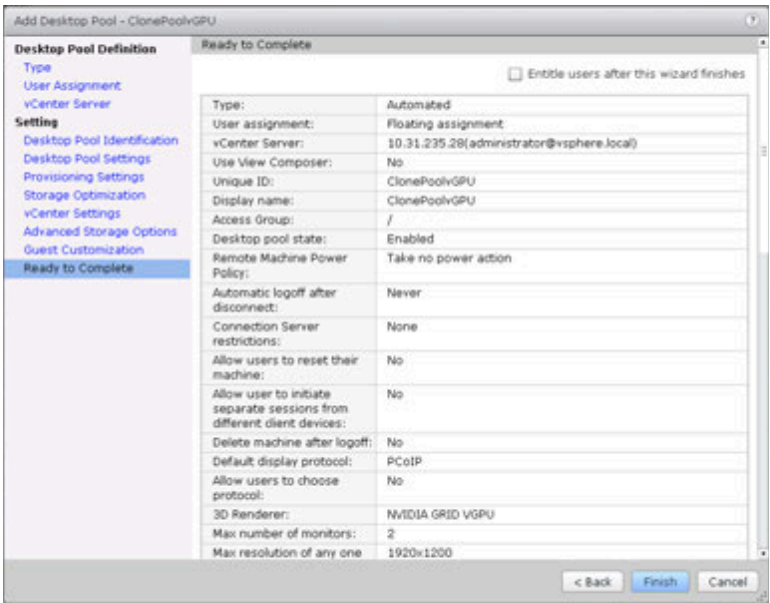
38. In advanced settings, click View Storage Accelerator if available. Choose blackout times for non-refresh of View Storage Accelerator cache to minimize impact on production users.



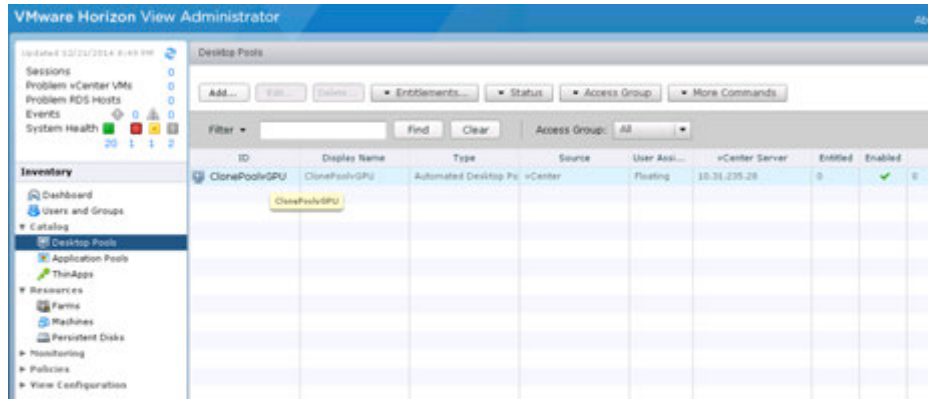
39. Select Use this customization specification to simplify deployment. Click Next to continue.



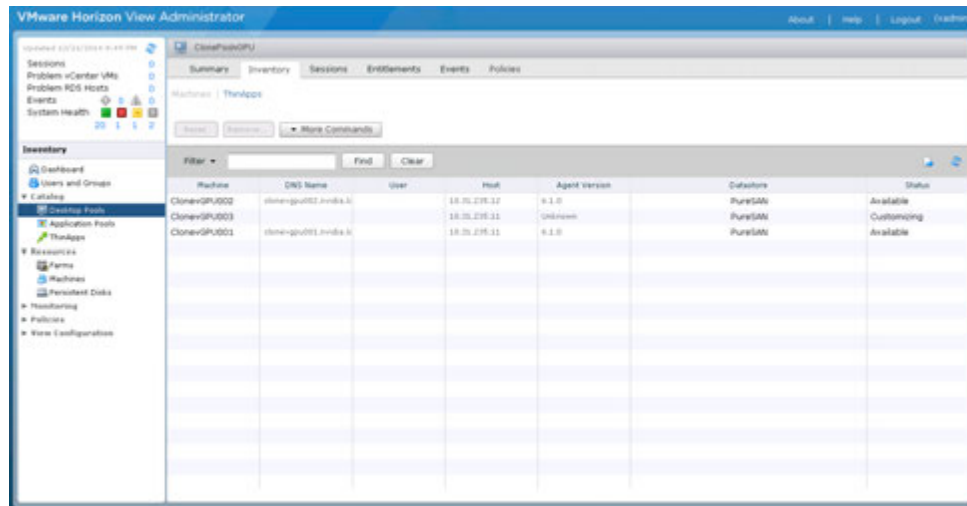
40. Review the selections, Click **Finish** to deploy the Desktop Pool.



41. Monitor Pool for status.



42. Look under Status on the far right column for “Available”. This means VDI desktops are ready for access.

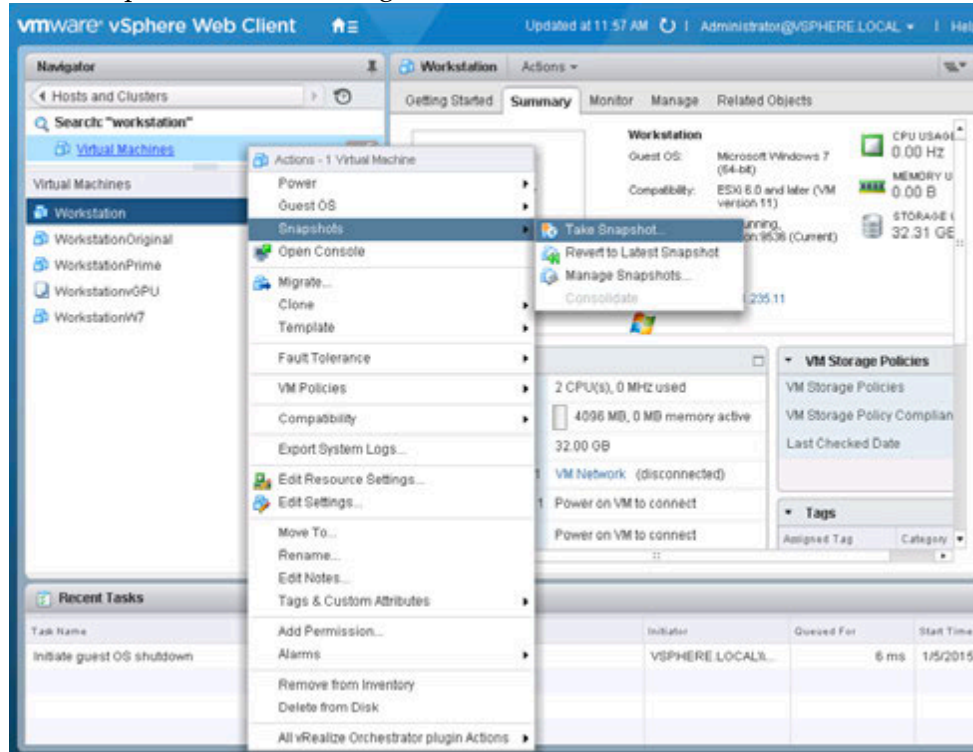


## 11.4 CREATING LINKED CLONE DESKTOP POOLS

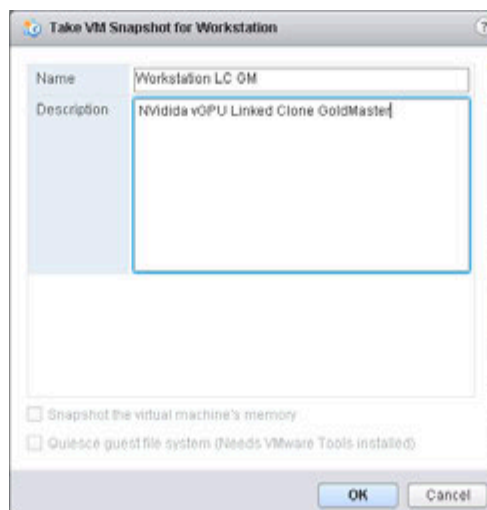
Creating a linked pool of VDI desktops is very similar to the full clone process. A linked pool leverages the View Composer to deploy multiple desktops off of one Goldmaster Image. Linked clones consume less disk space, are easily managed, upgraded and deployed with little impact on the enduser.

Similar to Clone Pools, we select a VM as Master Image. However instead of using a template of the Master VM, we take a snapshot of it. (Note: Run `ipconfig /release` in a command prompt prior to shutting down the Master VM to take the snapshot.)

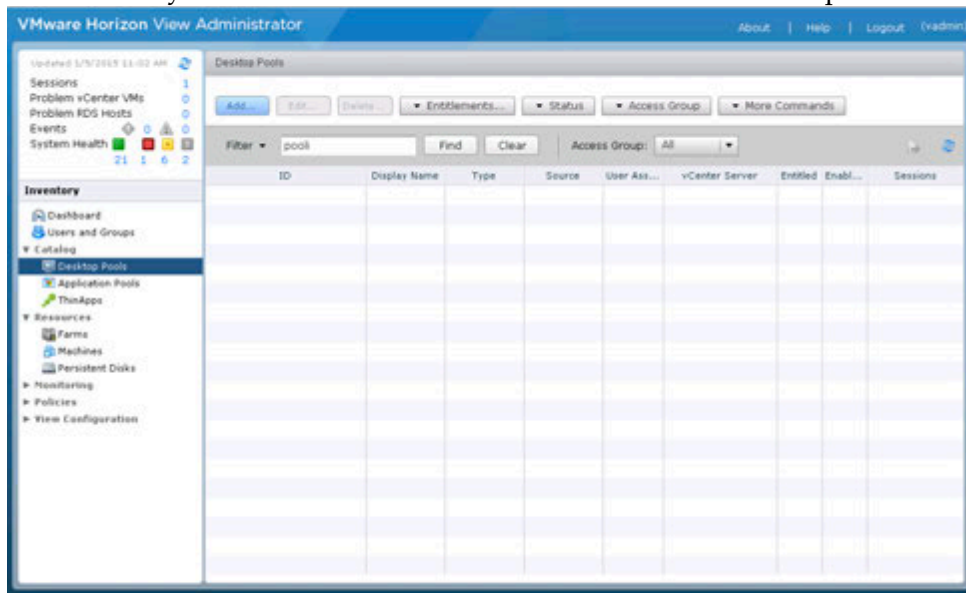
1. In the vSphere Web Client right click the Master VM.



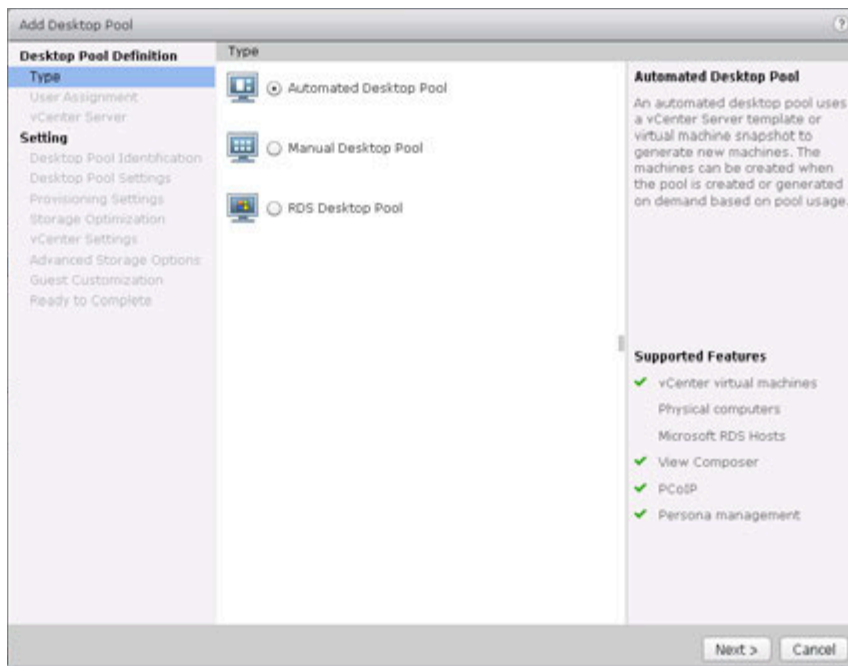
2. Name the Snapshot to conform to your VM naming standards with a meaningful description. Click OK to create snapshot.



3. In the VMware Horizon View Management Console, Select Desktop Pools in the Inventory window. Click the Add button to start the Desktop Pool wizard.

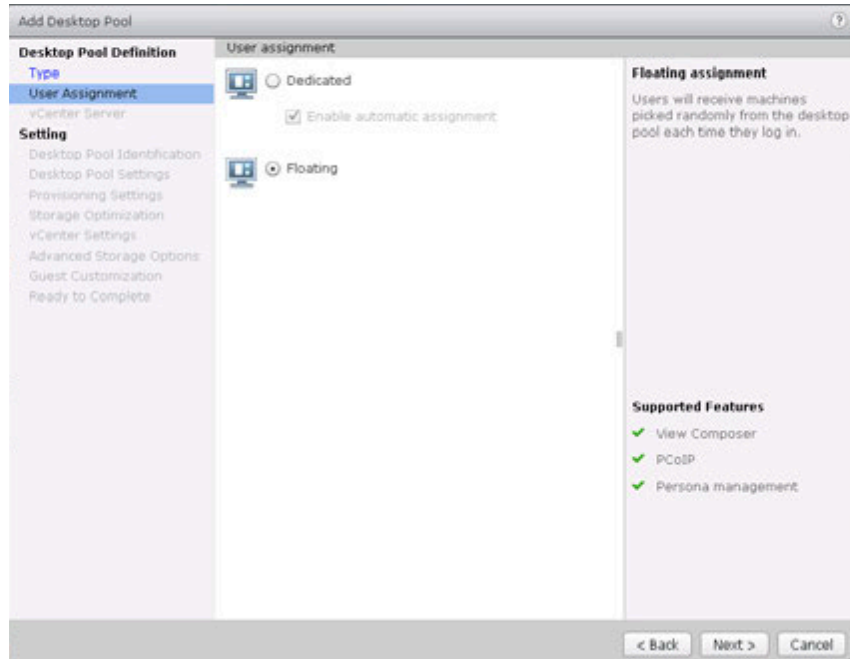


4. Select Automated Desktop Pool. Click on Next to continue.

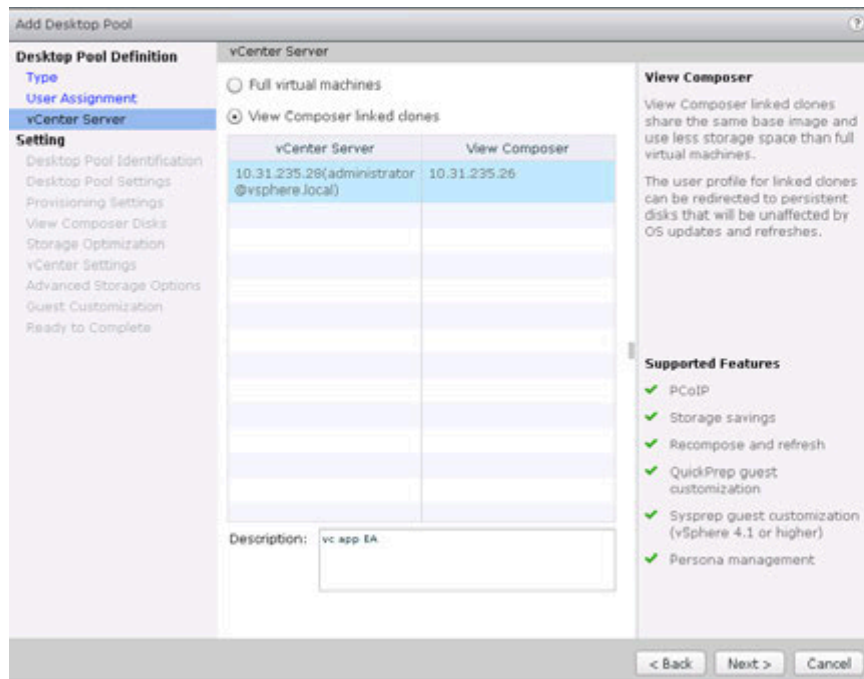


5. Select Floating for User Assignment. Click on Next to continue.





6. Select View Composer linked clones. Verify the vSphere Server and View Composer. Click on **Next** to continue.



The screenshot shows the 'Add Desktop Pool - LinkedClonePool' wizard. The left sidebar has a 'Setting' section with 'Desktop Pool Identification' selected. The main area is titled 'Desktop Pool Identification' and contains the following fields:

- ID:** LinkedClonePool
- Display name:** LinkedClonePool
- Access group:** /
- Description:** Linked Clone vGPU Pool for Testing

On the right, there are informational sections:

- ID:** The desktop pool ID is the unique name used to identify this desktop pool.
- Display Name:** The display name is the name that users will see when they connect to View Client. If the display name is left blank, the ID will be used.
- Access Group:** Access groups can organize the desktop pools in your organization. They can also be used for delegated administration.
- Description:** This description is only shown on the Settings tab for a desktop pool within View Administrator.

At the bottom right are buttons: '< Back', 'Next >', and 'Cancel'.

- Set the Remote Display Protocol to **PCoIP**, Set Allow users to choose to **No**, Set 3D Renderer to **NVIDIA GRID VGPU**. (In this version, HTML Access is fully supported and can be set to Enabled.)

The screenshot shows the 'Add Desktop Pool - LinkedClonePool' wizard, now on the 'Desktop Pool Settings' step. The left sidebar has 'Desktop Pool Settings' selected. The main area is titled 'restrictions:' and contains the following settings:

- Remote Settings:**
  - Remote Machine Power Policy: Take no power action
  - Automatically logoff after disconnect: Never
  - Allow users to reset their machines: No
  - Allow user to initiate separate sessions from different client devices: No
  - Delete or refresh machine on logoff: Never
- Remote Display Protocol:**
  - Default display protocol: PCoIP
  - Allow users to choose protocol: No
  - 3D Renderer: NVIDIA GRID VGPU (with a 'Configure...' button)
  - Max number of monitors: 2
  - Max resolution of any one monitor: 1920x1200
  - HTML Access: ☒ Enabled (with a note: 'Requires installation of HTML Access.')

At the bottom right are buttons: '< Back', 'Next >', and 'Cancel'.

- Configure the Provisions Settings to conform with your infrastructure and testing needs.

**Add Desktop Pool - LinkedClonePool**

**Desktop Pool Definition**

- Type
- User Assignment
- vCenter Server
- Setting**
  - Desktop Pool Identification
  - Desktop Pool Settings
  - Provisioning Settings**
  - View Composer Disks
  - Storage Optimization
  - vCenter Settings
  - Advanced Storage Options
  - Guest Customization
  - Ready to Complete

**Provisioning Settings**

**Basic**

- ☒ Enable provisioning
- ☒ Stop provisioning on error

**Virtual Machine Naming**

- ☐ Specify names manually
  - 0 names entered
  - ☐ Start machines in maintenance mode
  - # Unassigned machines kept powered on:
- ☒ Use a naming pattern
  - Naming Pattern:

**Desktop Pool Sizing**

- Max number of machines:
- Number of spare (powered on) machines:
- Minimum number of ready (provisioned) machines during View Composer maintenance operations:

**Provisioning Timing**

- ☒ Provision machines on demand
  - Min number of machines:
- ☐ Provision all machines up-front

**Naming Pattern**

Virtual machines will be named according to the specified naming pattern. By default, View Manager appends a unique number to the specified pattern to provide a unique name for each virtual machine.

To place this unique number elsewhere in the pattern, use "(n)". (For example: vm-(n)-sales.).

The unique number can also be made a fixed length. (For example: vm-{n.fixed=3}-sales.).

See the help for more naming pattern syntax options.

< Back **Next >** Cancel

- For simplicity, Select Do not redirect disposable files. Click on Next to continue.

**Add Desktop Pool - LinkedClonePool**

**Desktop Pool Definition**

- Type
- User Assignment
- vCenter Server
- Setting**
  - Desktop Pool Identification
  - Desktop Pool Settings
  - Provisioning Settings
  - View Composer Disks**
  - Storage Optimization
  - vCenter Settings
  - Advanced Storage Options
  - Guest Customization
  - Ready to Complete

**View Composer Disks**

**Disposable File Redirection**

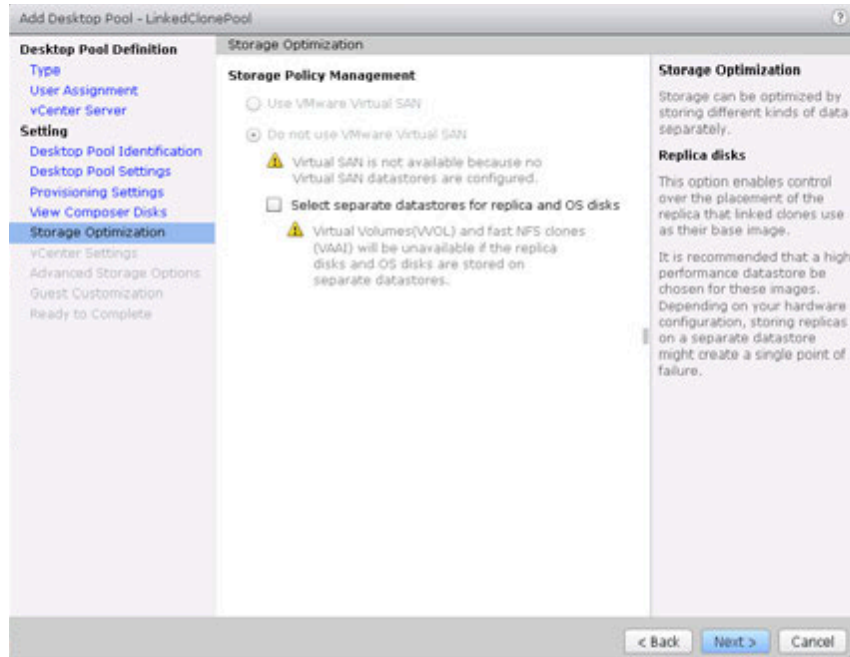
- ☐ Redirect disposable files to a non-persistent disk
  - Disk size:  MB (minimum 512 MB)
  - Drive letter:
- ☒ Do not redirect disposable files

**Disposable File Redirection**

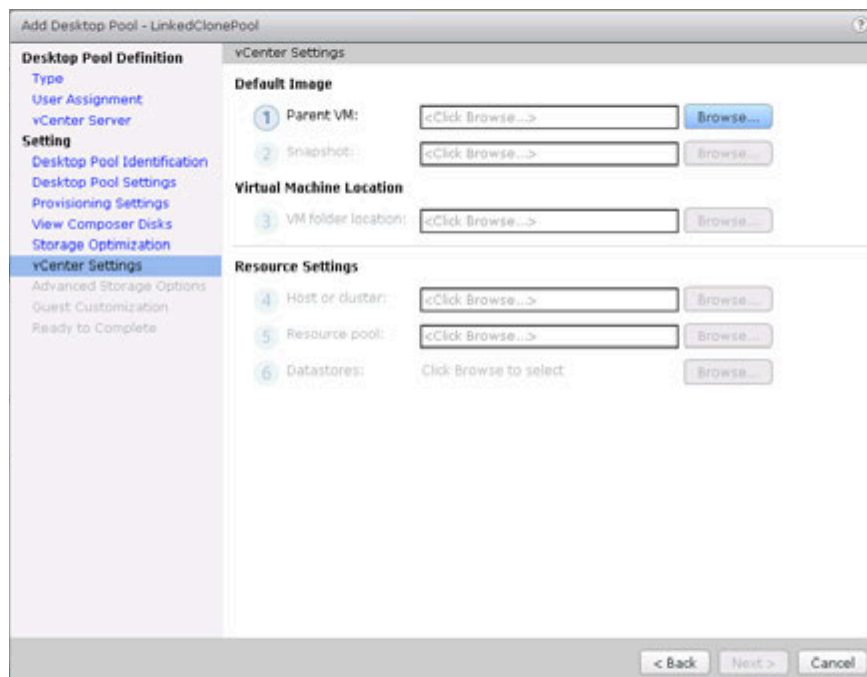
Use this option to redirect disposable files to a non-persistent disk that will be deleted automatically when a user's session ends.

< Back **Next >** Cancel

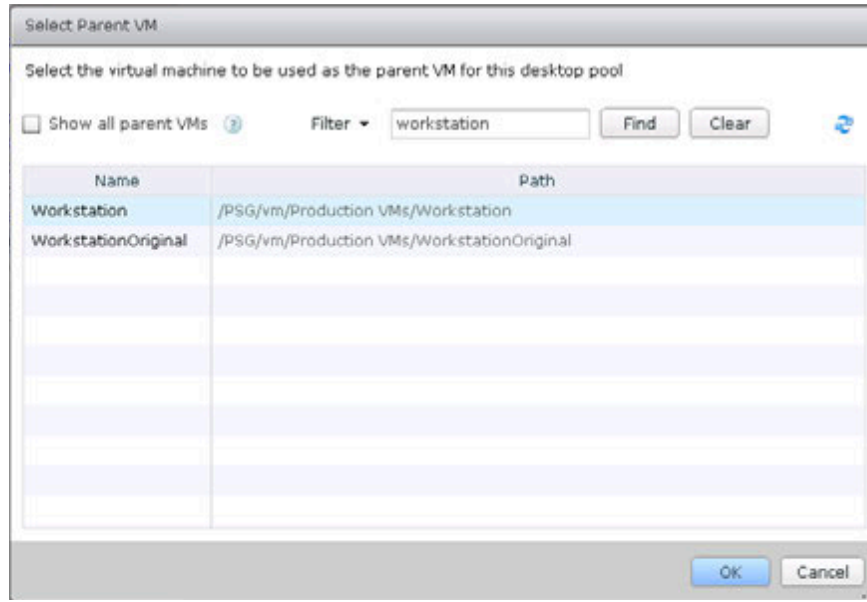
- Click on Next to continue.



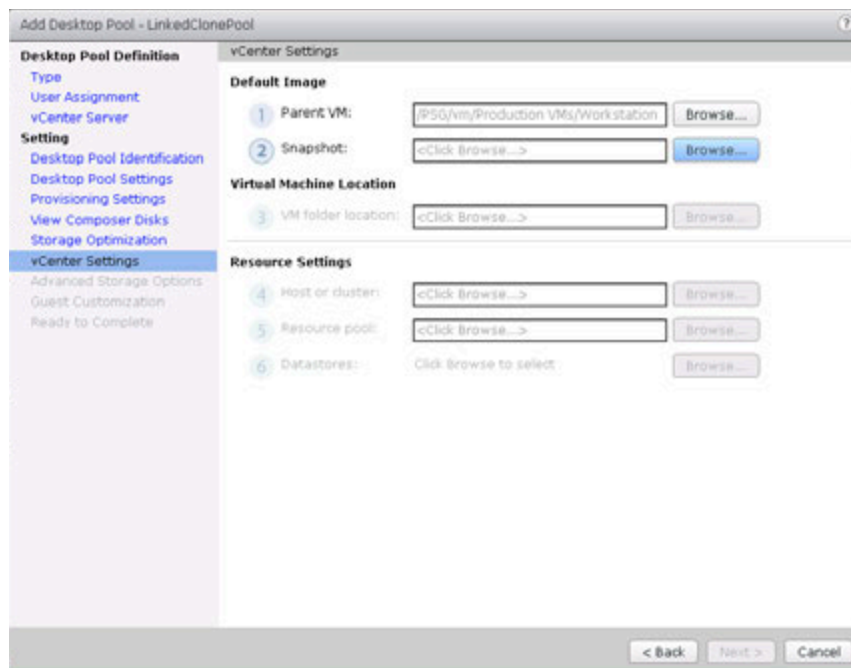
11. Click on the Browse button for the Parent VM.



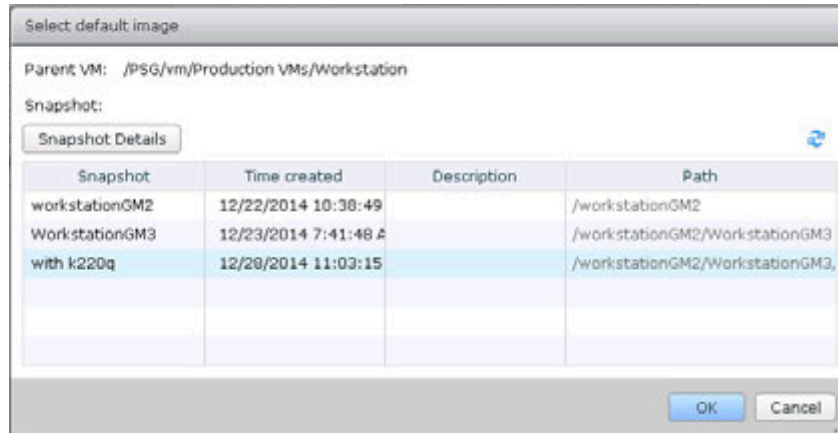
12. Select the Master VM. Use the Filter option help narrow the search. Click OK to continue.



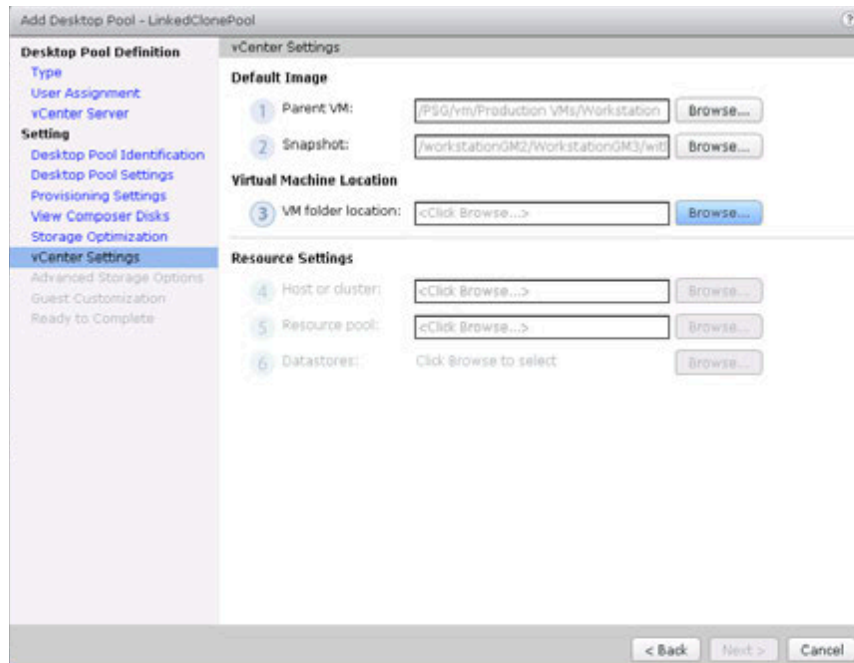
13. Click the **Browse** button and select the appropriate Snapshot.



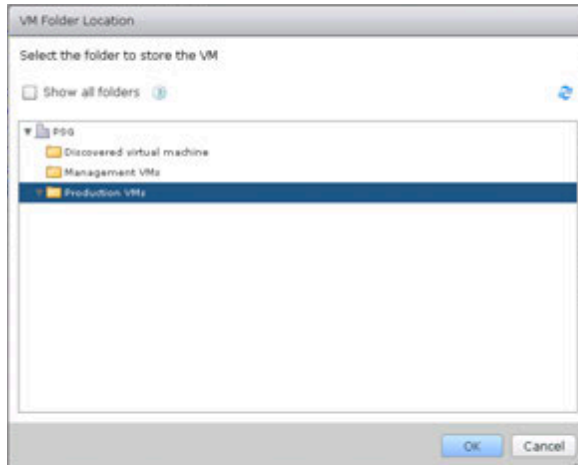
14. Select a Snapshot for the default image. Click **OK** to continue.



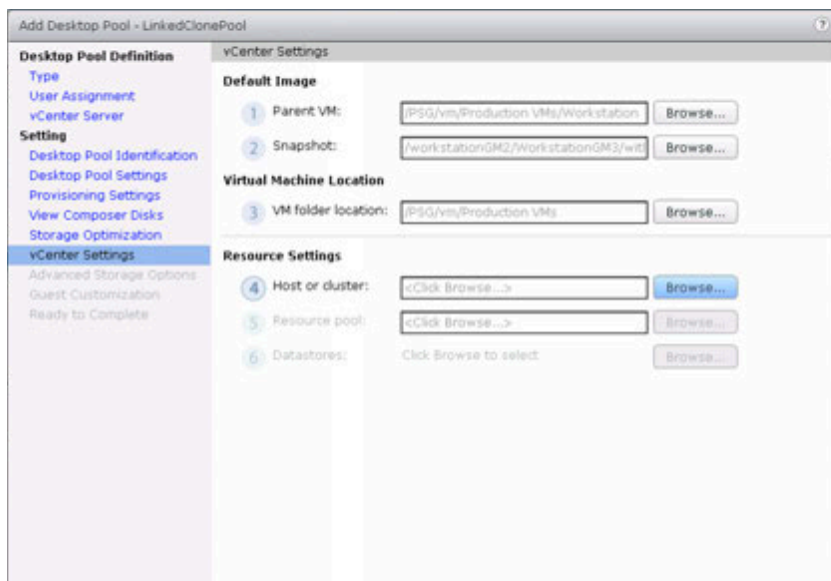
15. Click **Browse** for the VM folder location.



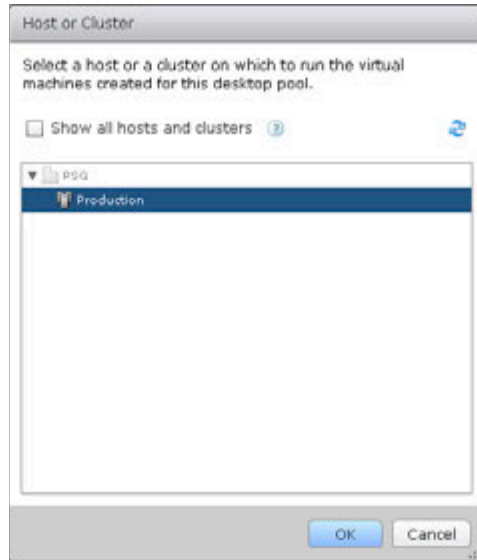
16. Navigate to VM Folder location, select a folder and click **OK** to continue.



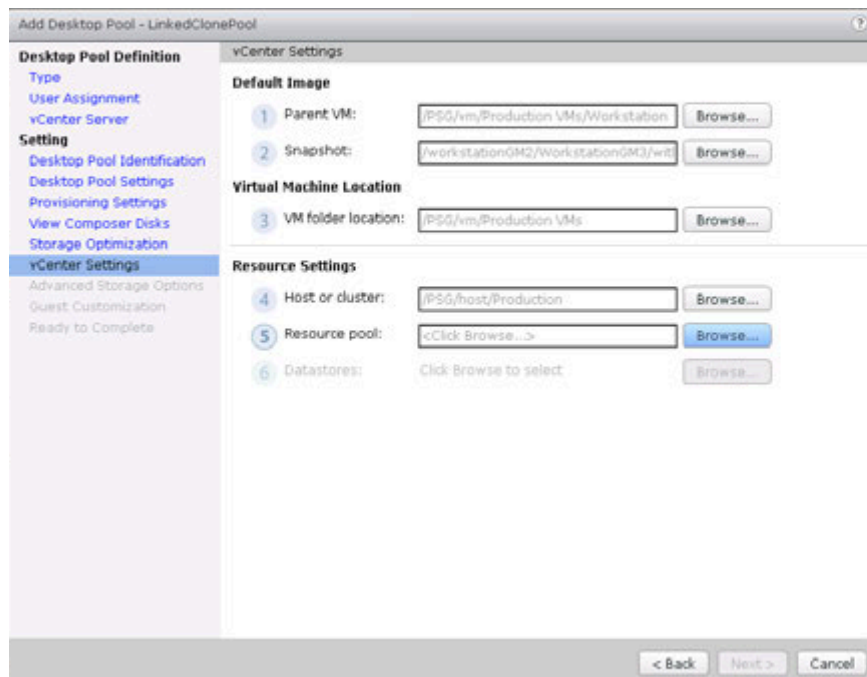
17. Click on **Browse** to Select a Host or Cluster, select the GRID vGPU cluster.



18. Navigate to Host or Cluster, select one and click **OK** to continue.

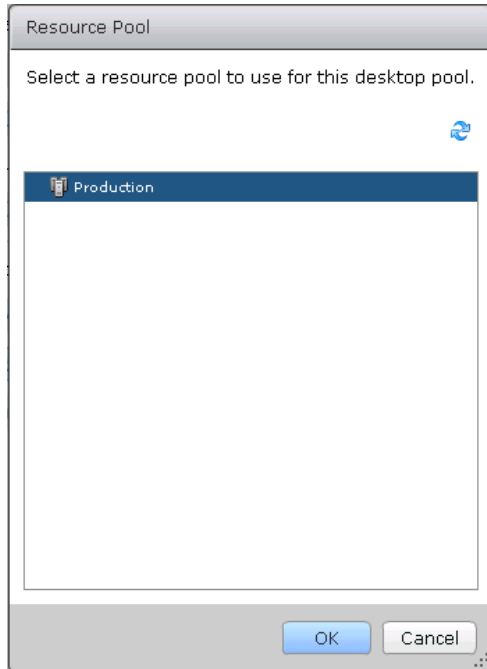


19. Click on **Browse** to select Resource pool.

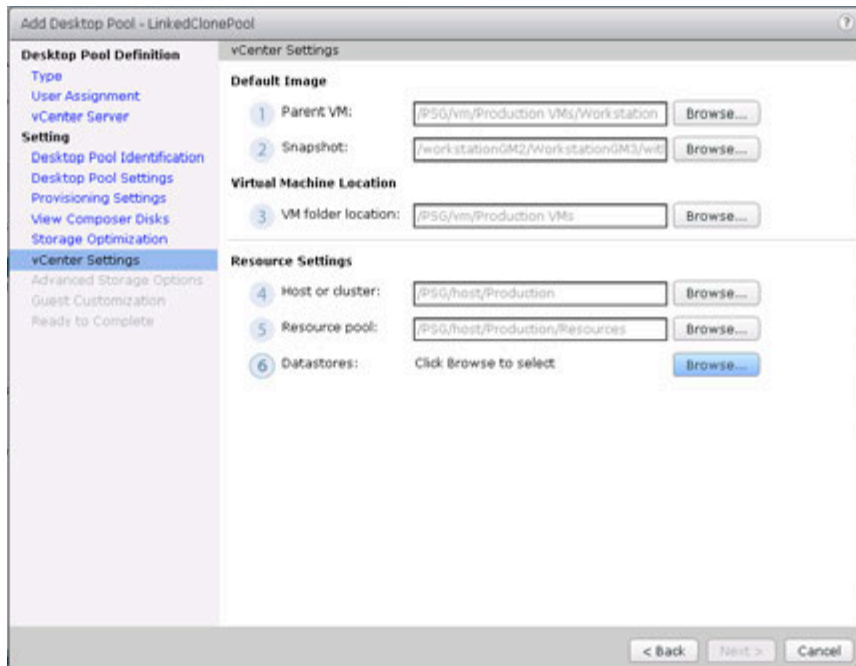


20. Navigate and select a Resource Pool. Click **OK** to continue.





21. Click **Browse** to select the Datastore for the linked clone pool.



22. Select a Datastore for the linked clone pool. Click **OK** to continue.

Select Linked Clone Datastores

Select the linked clone datastores to use for this desktop pool. Only datastores that can be used by the selected host or cluster can be selected.

☐ Show all datastores (including local datastores) ? Local datastore Shared datastore ?

	Datastore	Capacity (GB)	Free (GB)	FS Type	Drive Type	Storage Overcommit <span>?</span>
<input checked="" type="checkbox"/>	PureSAN	65,535.75	64,010.35	VMFS5	SSD	Conservative
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						
<input type="checkbox"/>						

Data Type	Selected Free Space (GB)	Min Recommended (GB)	50% utilization (GB)	Max Recommended (GB)
Linked clones	64,010.35	104.00	224.00	384.00

OK Cancel

23. Click Next to continue.

The screenshot shows the 'vCenter Settings' page of the 'Add Desktop Pool - LinkedClonePool' wizard. The left sidebar contains the following navigation items: Desktop Pool Definition, Type, User Assignment, vCenter Server, Setting (highlighted), Desktop Pool Identification, Desktop Pool Settings, Provisioning Settings, View Composer Disks, Storage Optimization, vCenter Settings (highlighted), Advanced Storage Options, Guest Customization, and Ready to Complete. The main content area is titled 'vCenter Settings' and contains three sections: 'Default Image' with two numbered steps (1. Parent VM: /PSG/vm/Production VMs/Work-station, 2. Snapshot: /workstationGM2/Work-stationGM3/wrt), 'Virtual Machine Location' with one numbered step (3. VM folder location: /PSG/vm/Production VMs), and 'Resource Settings' with three numbered steps (4. Host or cluster: /PSG/host/Production, 5. Resource pool: /PSG/host/Production/Resources, 6. Datastores: 1 selected). Each step has a 'Browse...' button. At the bottom right, there are three buttons: '< Back', 'Next >', and 'Cancel'.

Add Desktop Pool - LinkedClonePool

**Desktop Pool Definition**

- Type
- User Assignment
- vCenter Server

**Setting**

- Desktop Pool Identification
- Desktop Pool Settings
- Provisioning Settings
- View Composer Disks
- Storage Optimization
- vCenter Settings**
- Advanced Storage Options
- Guest Customization
- Ready to Complete

**vCenter Settings**

**Default Image**

- Parent VM: /PSG/vm/Production VMs/Work-station
- Snapshot: /workstationGM2/Work-stationGM3/wrt

**Virtual Machine Location**

- VM folder location: /PSG/vm/Production VMs

**Resource Settings**

- Host or cluster: /PSG/host/Production
- Resource pool: /PSG/host/Production/Resources
- Datastores: 1 selected

< Back   Next >   Cancel

24. Enable View Storage Accelerator and Reclaim VM disk space if available to improve performance and efficiency.

**Add Desktop Pool - LinkedClonePool**

**Desktop Pool Definition**

- Type
- User Assignment
- vCenter Server
- Setting**
  - Desktop Pool Identification
  - Desktop Pool Settings
  - Provisioning Settings
  - View Composer Disks
  - Storage Optimization
  - vCenter Settings
  - Advanced Storage Options**
  - Guest Customization
  - Ready to Complete

**Advanced Storage Options**

Based on your resource selection, the following features are recommended. Options that are not supported by the selected hardware are disabled.

☒ Use View Storage Accelerator

Disk Types: OS disks

Regenerate storage accelerator after: 7 Days

☒ Other Options

☐ Use native NFS snapshots (VAAI)

☒ Reclaim VM disk space

Initiate reclamation when unused space on VM exceeds: 1 GB

**Blackout Times**

Storage accelerator regeneration and VM disk space reclamation do not occur during blackout times. The same blackout policy applies to both operations.

Add... Edit... Remove

Day	Time

**View Storage Accelerator**

vSphere 5.x hosts can be configured to improve performance by caching certain desktop pool data. Enable this option to use View Storage Accelerator for this pool. View Storage Accelerator is most useful for shared disks that are read frequently, such as View Composer OS disks.

**Native NFS Snapshots (VAAI)**

VAAI (vStorage API for Array Integration) is a hardware feature of certain storage arrays. It uses native snapshotting technology to provide linked clone functionality. Choose this option only if you have appropriate hardware devices.

**Disk Space Reclamation**

With vSphere 5.x, virtual machines can be configured to use a space efficient disk format that supports reclamation of unused disk space (such as deleted files).

< Back Next > Cancel

25. Select QuickPrep for Guest Customization. Click Next to continue. (*QuickPrep is a VMware system tool executed by View Composer during a linked-clone desktop deployment. QuickPrep personalizes each desktop created from the Master Image.*)

**Add Desktop Pool - LinkedClonePool**

**Desktop Pool Definition**

- Type
- User Assignment
- vCenter Server
- Setting**
  - Desktop Pool Identification
  - Desktop Pool Settings
  - Provisioning Settings
  - View Composer Disks
  - Storage Optimization
  - vCenter Settings
  - Advanced Storage Options
  - Guest Customization**
  - Ready to Complete

**Guest Customization**

Domain: nvidia.lab(vadmin)

AD container: CN=Computers Browse...

☐ Allow reuse of pre-existing computer accounts

☒ Use QuickPrep

Power-off script name: Example: p1 p2 p3

Power-off script parameters: Example: p1 p2 p3

Post-synchronization script name: Example: p1 p2 p3

Post-synchronization script parameters: Example: p1 p2 p3

☐ Use a customization specification (Sysprep)

Name	Guest OS	Description
WorkstationCS	Windows	Workstation with vGPU Custom

< Back Next > Cancel

26. Review Add Desktop Pool settings. Click Back to fix any errors. Click Finish to create the pool.

Add Desktop Pool - LinkedClonePool

**Desktop Pool Definition**

- Type
- User Assignment
- vCenter Server
- Setting**
  - Desktop Pool Identification
  - Desktop Pool Settings
  - Provisioning Settings
  - View Composer Disks
  - Storage Optimization
  - vCenter Settings
  - Advanced Storage Options
  - Guest Customization
  - Ready to Complete

Ready to Complete

☐ Enable users after this wizard finishes

Type:	Automated
User assignment:	Floating assignment
vCenter Server:	10.31.235.28(administrator@vsphere.local)
Use View Composer:	Yes
Unique ID:	LinkedClonePool
Display name:	LinkedClonePool
Access Group:	/
Desktop pool state:	Enabled
Remote Machine Power Policy:	Take no power action
Automatic logoff after disconnect:	Never
Connection Server restrictions:	None
Allow users to reset their machine:	No
Allow user to initiate separate sessions from different client devices:	No
Delete or refresh machine on logoff:	Never
Default display protocol:	PCoIP
Allow users to choose protocol:	No
3D Renderer:	NVIDIA GRID VGPU
Max number of monitors:	2

< Back Finish Cancel

27. Monitor Linked Pool creation status. Refresh window using the recycle icon on left hand side.

VMware Horizon View Administrator

Updated: 1/17/2015 11:02 AM

Sessions: 1  
Problem vCenter VMs: 0  
Problem RDS Hosts: 0  
Events: 0  
System Health: 21 1 6 2

**Inventory**

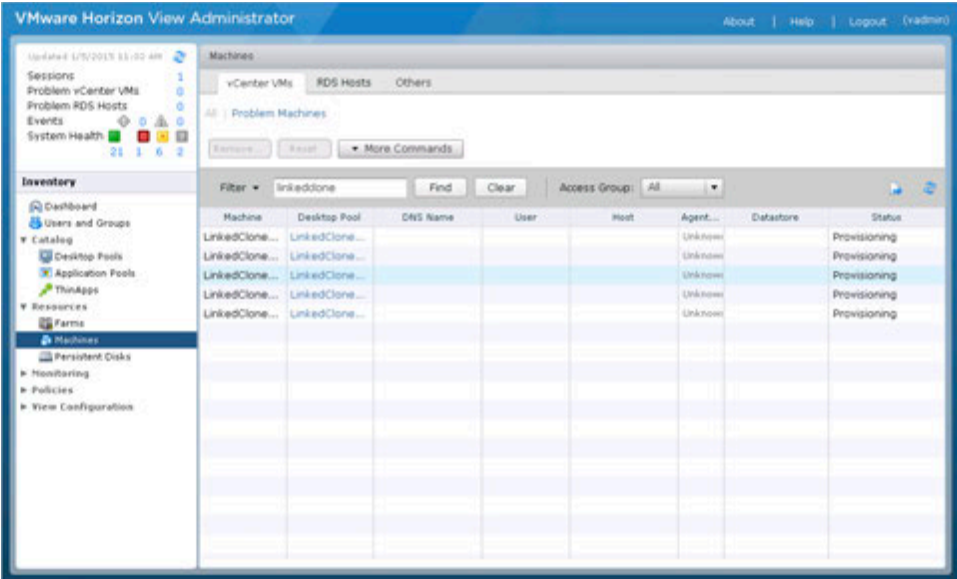
- Dashboard
- Users and Groups
- Catalog
  - Desktop Pools
  - Application Pools
  - ThinApps
- Resources
  - Farms
  - Machines
  - Persistent Disks
- Monitoring
- Policies
- View Configuration

**Desktop Pools**

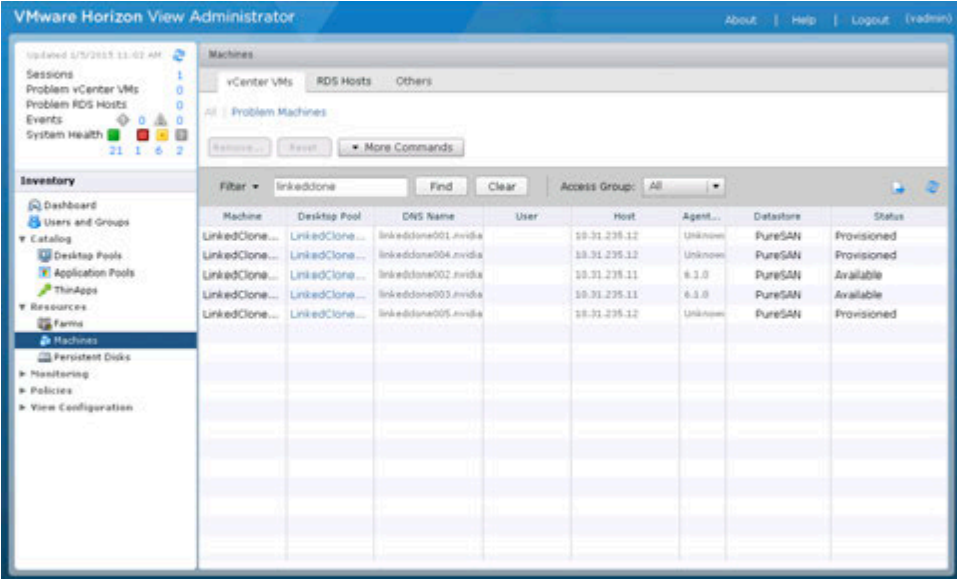
Filter: pool Find Clear Access Group: All

ID	Display Name	Type	Source	User Ass...	vCenter Server	Entitled	Enabl...	Sessions
LinkedClonePool	LinkedClonePo	Automated Del	vCenter (link)	Floating	10.31.235.28	0	✓	0

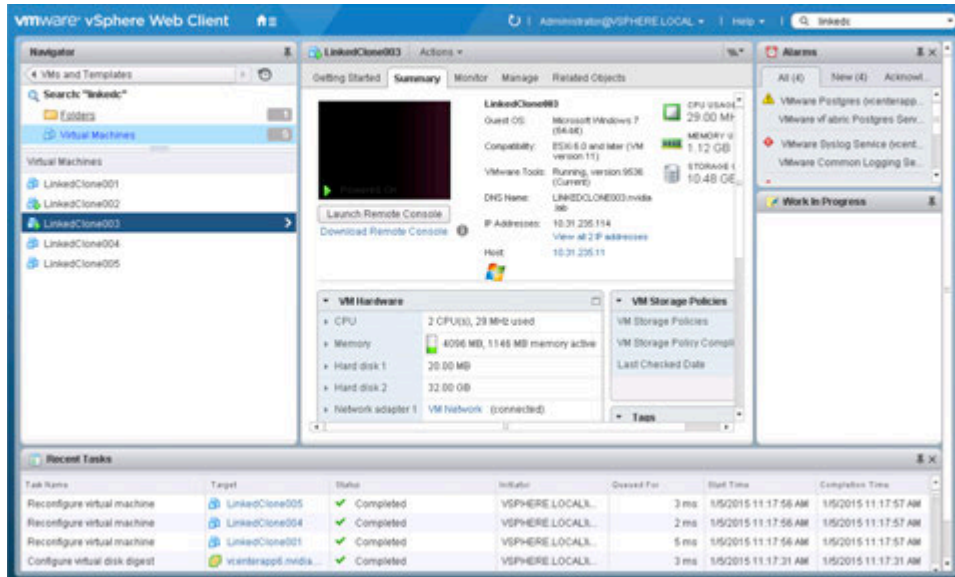
28. Click on Machines from the Inventory window, review status.



29. When status shows Available, then VDI desktops are ready.

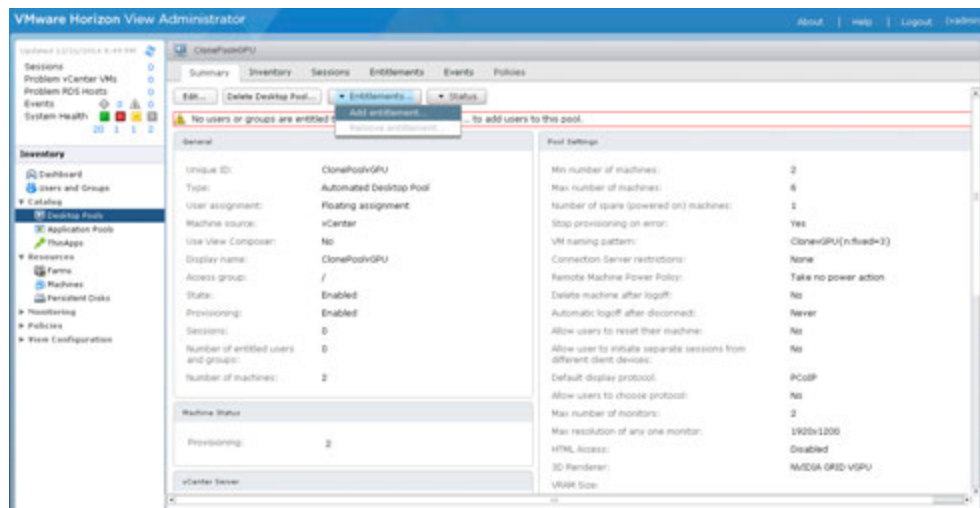


30. In the vSphere Web Client, the desktop VMs will appear.

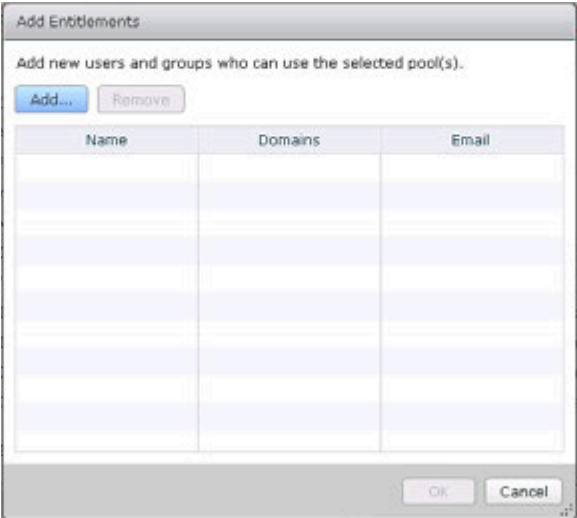


## 11.5 ENTITLING USERS ACCESS TO DESKTOP POOLS

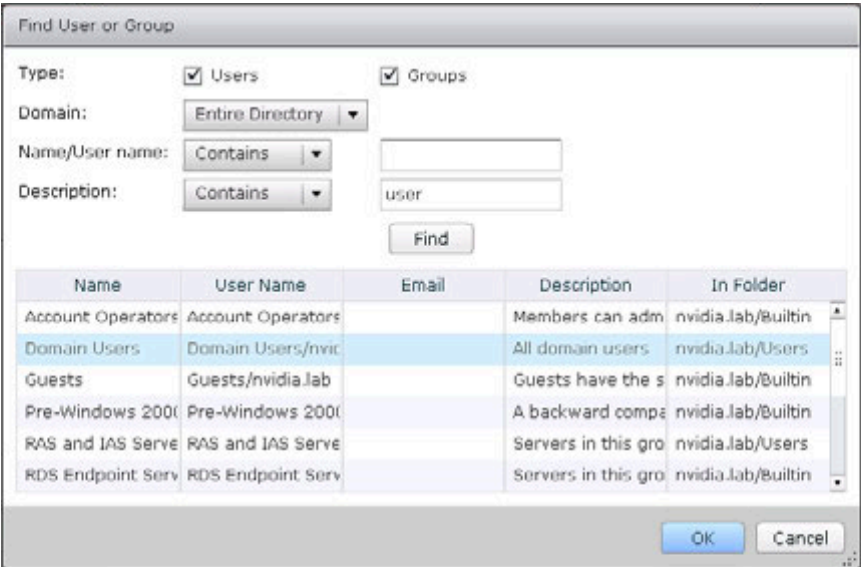
1. Entitle Users to access desktops in the pool. Select **Add entitlement** from the Entitlements button.



2. In the Add Entitlements pop up, click on Add...



3. Type in a string to search for users or groups. Highlight Users or Groups to Entitle in the search results below and click OK to add them.

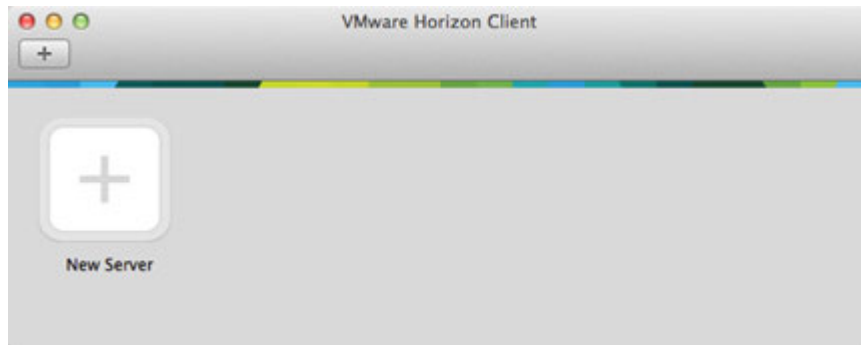


# 11.6 CONNECTING VMWARE HORIZON CLIENT TO THE VIEW CONNECTION SERVER

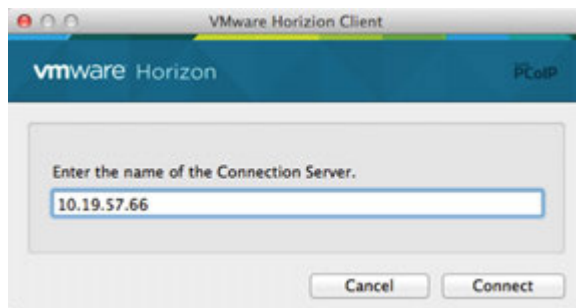
Use the following procedure to connect a VMware Horizon client to the View connection server:



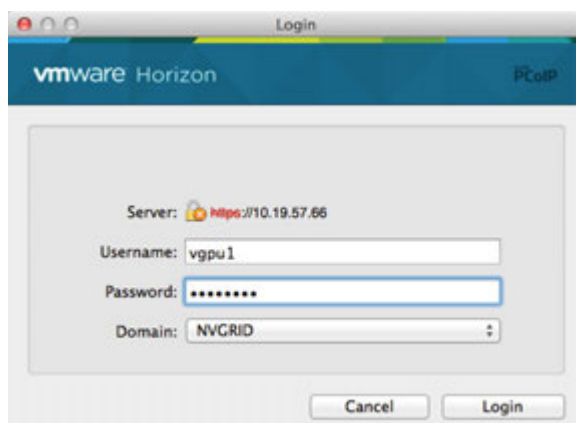
1. Launch the VMware Horizon client
2. Select the **New Server** (plus sign) icon.



3. Enter the server name or IP address in the **Enter the name of the Connection Server** field.
4. Select **Connect** to display the **Login** popup.

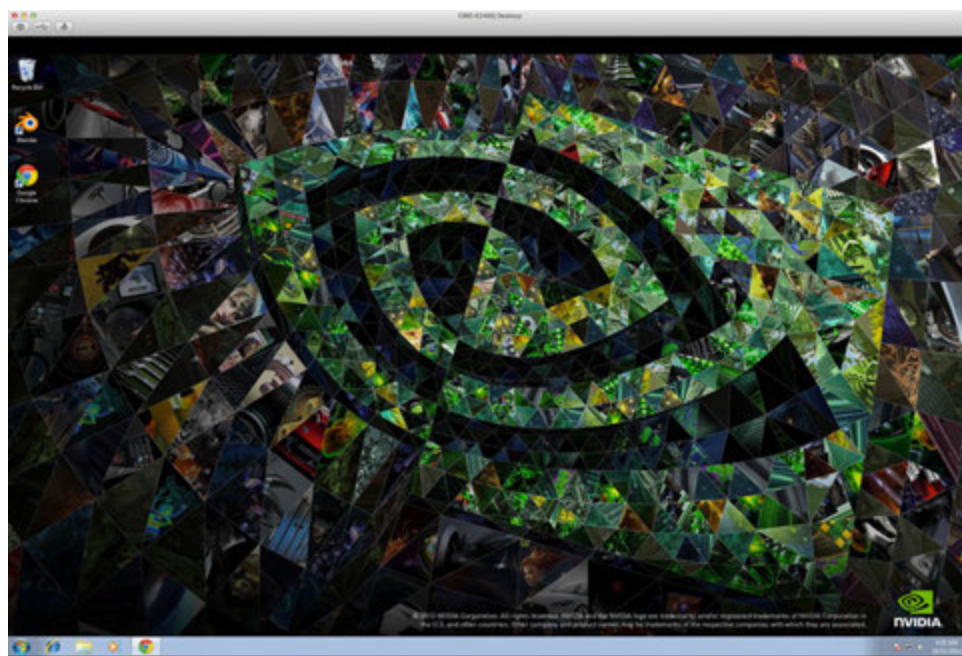


5. Enter the username and password of a user who is a member of the domain and who has been granted a desktop pool entitlement. Select **Login** to display a list of available vGPU-enabled desktop pool(s). Double-click the desktop you want to connect to.



6. Success, you are now logged in.





# Chapter 12.

## TESTING, MONITORING, & BENCHMARKING

This chapter describes various means of testing and benchmarking your NVIDIA GRID installation, including:

- ▶ NVIDIA System Management Interface (NSMI)
- ▶ Testing and simulation applications and tools

### 12.1 TESTING VIRTUAL DESKTOPS VS PHYSICAL ONES, AN IMPORTANT DIFFERENCE!

It's important to note that virtualization is a shared environment, allowing for efficiencies and administrative ease that are impossible with bare metal installs across the enterprise. Where a physical workstation or PC is one solution that meets a variety of business requirements, virtualizing those same workloads is a very different solution. As a result the testing and benchmarking must be looked at in a similar light. Where the goal on bare metal is to maximize performance at that desktop, with virtual desktops the goal is to maximize performance not only at the desktop, but also all the way out to whatever device over whatever bandwidth the end user is connecting with.

## 12.2 NVIDIA SYSTEM MANAGEMENT INTERFACE

The NVIDIA System Management Interface (NSMI) is a command line utility based on the NVIDIA Management Library (NVML). The NVML helps you manage and monitor NVIDIA GPU devices by allowing you to query and (if you have the appropriate privileges) modify the GPU device state. Information can be reported in either XML or human-readable plain text using either standard or file output. Refer to the *NSMI* documentation and see Chapter 14, Troubleshooting, on page 210 for more information.



NSMI is designed for Tesla and Fermi-based Quadro devices; however, it does offer limited support for other NVIDIA GPUs as well.

NSMI ships with the graphics drivers for the following operating systems:

- ▶ 64-bit Windows Server 2008R2
- ▶ 64-bit Windows 7
- ▶ Linux

### 12.2.1 Querying NSMI

To obtain a system-wide overview of the NVIDIA GPUs, call the **nvidia-smi** command without any arguments:

```
$ nvidia-smi
```

In the following example system output, a single virtual machine **Win7-c01** is utilizing a GRID K2 with the **K240Q vGPU** profile, and the GPU utilization for the GPU that is hosting the vGPU profile is **7%**.



The NSMI documentation is available at [http://developer.download.nvidia.com/compute/cuda/6\\_0/rel/gdk/nvidia-smi.331.38.pdf](http://developer.download.nvidia.com/compute/cuda/6_0/rel/gdk/nvidia-smi.331.38.pdf).

```
+-----+
| NVIDIA-SMI 340.49      Driver Version: 340.49   |
+-----+-----+-----+-----+
| GPU Name   Persistence-M | Bus-Id Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap|  Memory-Usage | GPU-Util    Compute M. |
+-----+-----+-----+-----+
| 0        0   GRID K2    Off|0000:09:00.0 Off|             Off      |
|N/A  52C    P8      30W / 117W |917MiB/4095MiB |  7%      Default   |
+-----+-----+-----+-----+
| 1        1   GRID K2    Off|0000:0A:00.0 Off|             Off      |
```

	N/A	43C	P0	50W / 117W	11MiB/4095MiB		0%	Default	
+-----+-----+-----+									
	2	GRID	K2	Off 0000:85:00.0	Off	Off			
	N/A	42C	P0	51W / 117W	11MiB /4095MiB		0%	Default	
+-----+-----+-----+									
	3	GRID	K2	Off 0000:86:00.0	Off	Off			
	N/A	37C	P0	39W / 117W	11MiB /4095MiB		0%	Default	
+-----+-----+-----+									
+-----+-----+-----+									
	Compute processes:			GPU Memory					
	GPUPID	Process name		Usage					
	=====								
	0	37336	Win7-c01	896MiB					
+-----+-----+-----+									

## 12.2.2 Monitoring

Adding command switches allows you to use NSMI to monitor GPU performance metrics. To monitor the GPU utilization for the GPU hosting the vGPU (not the vGPU utilization) in the section 12.2.1, Querying NSMI example on page 200, use the following command switches:

- ▶ **-id** is the PCI address of the device being queried. You can determine the address from the **nvidia-smi** output or by using the **gpupwm** command.
- ▶ **-format** is the desired output format (CSV format, in this example).
- ▶ **-query** is the types of data you wish to query and output. Be sure to separate data using commas, and refrain from using spaces.
- ▶ **-l** is the number of seconds to loop the query (3 seconds in this example)
- ▶ **> Win7-c01-GPU.log** redirects the console output into a file.

Press **[CTRL]+[C]** to stop logging.

This following example logs GPU performance to the file Win7-c01- GPU.log:

```
$ nvidia-smi --id=000:09:00.0 --format=csv --query-
gpu=utilization.gpu,utilization.memory,memory.
total,memory.used,memory.free -l 3 > Win7-c01-GPU.log
```

Begin collecting GPU metrics by launching an application. When finished, press **[CTRL]+[C]** to stop logging.

Use the following command to display the logging results:

```
$ cat Win7-c01-GPU.log
```

The system returns output similar to the following:

```
utilization.gpu [%], utilization.memory [%], memory.total [MiB],
memory.used [MiB], memory.free [MiB]
0 %, 0 %, 4095 MiB, 915 MiB, 3180 MiB
26 %, 12 %, 4095 MiB, 915 MiB, 3180 MiB
9 %, 1 %, 4095 MiB, 916 MiB, 3179 MiB
17 %, 3 %, 4095 MiB, 916 MiB, 3179 MiB
34 %, 22 %, 4095 MiB, 916 MiB, 3179 MiB
34 %, 23 %, 4095 MiB, 916 MiB, 3179 MiB
39 %, 25 %, 4095 MiB, 916 MiB, 3179 MiB
29 %, 12 %, 4095 MiB, 916 MiB, 3179 MiB
25 %, 12 %, 4095 MiB, 916 MiB, 3179 MiB
55 %, 33 %, 4095 MiB, 916 MiB, 3179 MiB
35 %, 6 %, 4095 MiB, 916 MiB, 3179 MiB
30 %, 5 %, 4095 MiB, 916 MiB, 3179 MiB
37 %, 6 %, 4095 MiB, 916 MiB, 3179 MiB
```

```

15 %, 1 %, 4095 MiB, 916 MiB, 3179 MiB
11 %, 1 %, 4095 MiB, 916 MiB, 3179 MiB
21 %, 1 %, 4095 MiB, 916 MiB, 3179 MiB
25 %, 4 %, 4095 MiB, 916 MiB, 3179 MiB
26 %, 5 %, 4095 MiB, 916 MiB, 3179 MiB
27 %, 5 %, 4095 MiB, 916 MiB, 3179 MiB
16 %, 1 %, 4095 MiB, 916 MiB, 3179 MiB
10 %, 1 %, 4095 MiB, 916 MiB, 3179 MiB
26 %, 12 %, 4095 MiB, 916 MiB, 3179 MiB
28 %, 6 %, 4095 MiB, 916 MiB, 3179 MiB
29 %, 6 %, 4095 MiB, 916 MiB, 3179 MiB
31 %, 7 %, 4095 MiB, 916 MiB, 3179 MiB
33 %, 7 %, 4095 MiB, 916 MiB, 3179 MiB
20 %, 4 %, 4095 MiB, 916 MiB, 3179 MiB
37 %, 7 %, 4095 MiB, 916 MiB, 3179 MiB
24 %, 5 %, 4095 MiB, 916 MiB, 3179 MiB
24 %, 5 %, 4095 MiB, 916 MiB, 3179 MiB
9 %, 1 %, 4095 MiB, 916 MiB, 3179 MiB
51 %, 8 %, 4095 MiB, 916 MiB, 3179 MiB
52 %, 8 %, 4095 MiB, 916 MiB, 3179 MiB
53 %, 9 %, 4095 MiB, 916 MiB, 3179 MiB
56 %, 9 %, 4095 MiB, 916 MiB, 3179 MiB
54 %, 9 %, 4095 MiB, 916 MiB, 3179 MiB
44 %, 8 %, 4095 MiB, 916 MiB, 3179 MiB
44 %, 8 %, 4095 MiB, 916 MiB, 3179 MiB
46 %, 7 %, 4095 MiB, 916 MiB, 3179 MiB
10 %, 1 %, 4095 MiB, 916 MiB, 3179 MiB
29 %, 4 %, 4095 MiB, 917 MiB, 3178 MiB
43 %, 9 %, 4095 MiB, 917 MiB, 3178 MiB
44 %, 9 %, 4095 MiB, 917 MiB, 3178 MiB
45 %, 9 %, 4095 MiB, 917 MiB, 3178 MiB
2 %, 0 %, 4095 MiB, 915 MiB, 3180 MiB

```

You can use a graphing application to display the overall GPU utilization and GPU memory utilization.

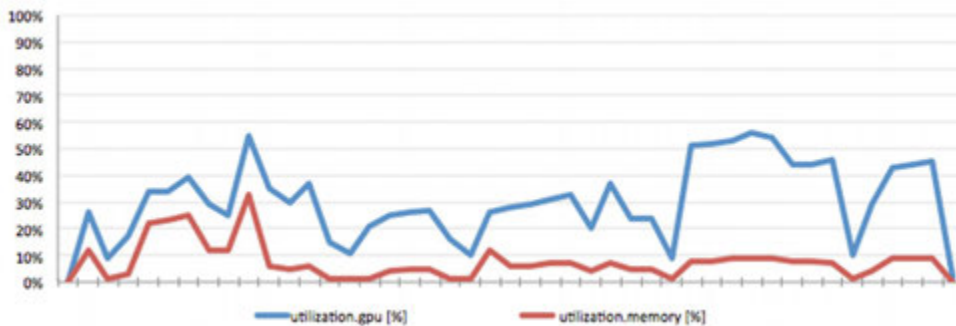


Figure 12-1. Graphed Log Output

## 12.3 TESTING/SIMULATING APPS AND TOOLS

This section contains numerous examples of tools and applications used for testing performance, benchmarking, and other verification purposes.

### 12.3.1 Browsers

- ▶ HTML 5 (Fishbowl): [ie.microsoft.com/testdrive](http://ie.microsoft.com/testdrive)
- ▶ Internet Explorer: <http://windows.microsoft.com/en-us/internet-explorer/download-ie>
- ▶ Chrome: [chrome.google.com](http://chrome.google.com)
- ▶ Firefox: [www.mozilla.org/firefox](http://www.mozilla.org/firefox)
- ▶ FaceBook: [www.facebook.com](http://www.facebook.com)
- ▶ NVIDIA: [www.nvidia.com](http://www.nvidia.com)
- ▶ ESPN: [www.espn.com](http://www.espn.com)

### 12.3.2 Microsoft

- ▶ Office 2013 (turn on and off GPU Acceleration): <http://www.microsoft.com/en-us/evalcenter/evaluate-office-professional-plus-2013>

### 12.3.3 Dassault

- ▶ SolidWorks: <http://www.solidworks.com/sw/purchase/solidworks-trial.htm>
- ▶ eDrawings Horizons (SolidWorks Horizons): <http://www.edrawingsHorizons.com/ed/download.htm>
- ▶ Samples (SeaScooter, etc.): <http://www.edrawingsHorizons.com/ed/edrawings-samples.htm>
- ▶ Catia: [www.3ds.com/products-services/catia](http://www.3ds.com/products-services/catia)

### 12.3.4 PTC

- ▶ Creo: [www.ptc.com/product/creo](http://www.ptc.com/product/creo)

### 12.3.5 Siemens

- ▶ Siemens NX: [http://www.plm.automation.siemens.com/en\\_us/products/nx/](http://www.plm.automation.siemens.com/en_us/products/nx/)

## 12.3.6 OpenGL

- ▶ FurMark: <http://www.ozone3d.net/benchmarks/fur>
- ▶ Unigine: <http://unigine.com/products/benchmarks/>
  - Heaven (newest): <http://unigine.com/products/heaven/>
  - Valley: <http://unigine.com/products/valley/>
  - Tropics: <http://unigine.com/products/tropics/>
  - Sanctuary: <http://unigine.com/products/sanctuary/>

## 12.3.7 Lego Designer

- ▶ Lego Designer: <http://ldd.lego.com/en-us/>

## 12.3.8 Adobe

- ▶ Reader: [get.adobe.com/reader](http://get.adobe.com/reader)
- ▶ Acrobat: [www.adobe.com/Acrobat\\_XI](http://www.adobe.com/Acrobat_XI)
- ▶ Creative Cloud Suite: [www.adobe.com/CreativeCloud](http://www.adobe.com/CreativeCloud)
- ▶ PhotoShop (with high-resolution images): [www.adobe.com/Photoshop](http://www.adobe.com/Photoshop)
- ▶ Illustrator: [www.adobe.com/Illustrator](http://www.adobe.com/Illustrator)

## 12.3.9 BitSquid Stone Giant

- ▶ Bitsquid Stone Giant: [http://www.bitsquid.se/gallery-stone\\_giant.html](http://www.bitsquid.se/gallery-stone_giant.html)

## 12.3.10 Google Earth

- ▶ Locally installed: <https://www.google.com/earth/explore/products/desktop.html>
- ▶ Chrome delivered: <https://www.google.com/earth/explore/products/plugin.html>

## 12.3.11 Hulu/YouTube videos

- ▶ Try an assortment of videos with dialogue, as this is critical for the video playback test (making sure lips are moving in time with the audio).

## 12.3.12 Redway Turbine 3D

- ▶ Redway Turbine 3D: <http://www.redway3d.com/news/news290609.php>



### 12.3.13 AutoDesk

- ▶ AutoCAD: <http://www.autodesk.com/products/autocad/free-trial>
- ▶ Revit: <http://www.autodesk.com/products/revit-family/free-trial>
- ▶ Revit samples: <http://grabcad.com/library/software/autodesk-revit>
- ▶ Inventor 2015 SP1 Update 2

### 12.3.14 Slicer3D

- ▶ Slicer 3D: <http://download.slicer.org/>

### 12.3.15 FutureMark

- ▶ 3DMark: <http://www.futuremark.com/benchmarks/3dmark>
- ▶ PCMark: <http://www.futuremark.com/benchmarks/pcmark8>

# Chapter 13.

## KNOWN ISSUES

This section lists some of the known issues that are current as of the publication date of this manual.

### 13.1 UNINSTALLING EXISTING VSGA VIB TO INSTALL THE NVIDIA VGPU VIB

You must uninstall an existing **NVIDIA VIB** file *before* installing a new vSGA or vGPU **VIB**. As of this publication, the **NVIDIA VIBs** for vSGA and vGPU are mutually exclusive.

To uninstall the **NVIDIA VIB** file for the purposes of upgrading the vib, issue the following command:

```
esxcli software vib remove -n NVIDIA-vgx-VMware_vSphere_6_Host_Driver
```

The output should be:

```
Removal Result
  Reboot Required: false VIBs Installed:
  VIBs Removed: NVIDIA_bootbank_NVIDIA-vgx-
  VMware_vSphere_6_Host_Driver_340.49- 1OEM.600.0.0.1951118 2014-10-06
  VIBs Skipped:
```

To verify the installation status of the **NVIDIA VIB**, issue the following command in a vSphere shell:

```
esxcli software vib list | grep NVIDIA
```

- ▶ If an **NVIDIA VIB** is not installed, the command will not return any output.
- ▶ If an **NVIDIA .VIB** is installed, the output will be:

```
NVIDIA-vgx-VMware_vSphere_6_Host_Driver 340.49-1OEM.600.0.0.1951118
NVIDIA VMwareAccepted 2014-10-06
```

## NVIDIA WDDM Issues

After installing the NVIDIA WDDM driver in a VM and connecting with Horizon Client, the desktop will not be visible from the HostClient console.

- ▶ Without a console, the vSphere Web Client can still provide the IP address of a VM.
- ▶ With Horizon Agent Direct Connection, a Horizon Client can connect directly to the IP address of a VM.

## 13.2 VGPU-ENABLED VMS AND NVIDIA-SMI FAIL TO START.

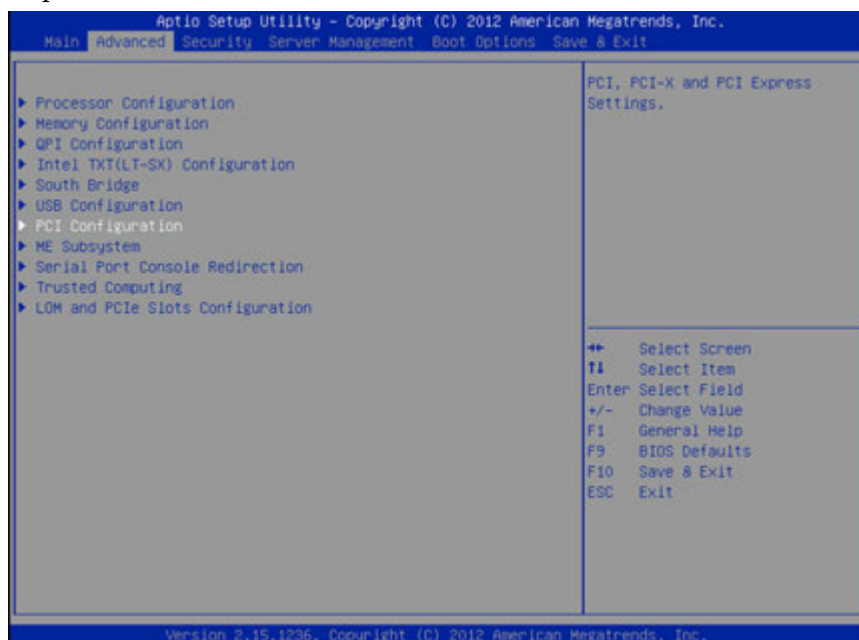
If vGPU-enabled VMs are assigned too high a proportion of the server's total memory, one of more of the VMs may fail to start with the error "**The available Memory resources in the parent resource pool are insufficient for the operation**", and nvidia-smi run in the host shell returns the error "**-sh: can't fork**".

For example, on a server configured with 256G of memory, these errors may occur if vGPU-enabled VMs are assigned more than 243G of memory. Reduce the total amount of system memory assigned to the VMs.

## 13.3 INSTALLATION ON A CISCO UCS240M3

The error message **Error loading /tools.t00 Fatal error: 10 (Out of resources)** may occur when installing vSphere 5.5. Use the following procedure to resolve this issue:

1. Enter the system BIOS by pressing **[F2]**.
2. Select the **Advanced** tab in CIMS.
3. Expand the **PCI Configuration** section.



4. Change the **MMCFG BASE** setting from **Auto** to **2GB**.
5. Save your changes and reboot the system.
6. Reinstall vSphere.

## 13.4 VMOTION AND DRS NOT SUPPORTED

Virtual machines utilizing vGPU, or vDGA/pass-through, or SR-IOV, do not support vMotion or similar live motion functionality due to the dependence on a physical hardware resource. Cold motion, shutting down the virtual machine and moving it to another identically GPU equipped host, works well.

# Chapter 14.

## TROUBLESHOOTING

This section contains procedures for resolving common issues.



Before troubleshooting or filing a bug report, review the release notes for information about known issues with the current release, and potential workarounds.

### 14.1 TROUBLESHOOTING PROCEDURE

If a vGPU-enabled virtual machine either fails to start or does not display any output when it does start, follow these procedures to narrow down the probable cause.

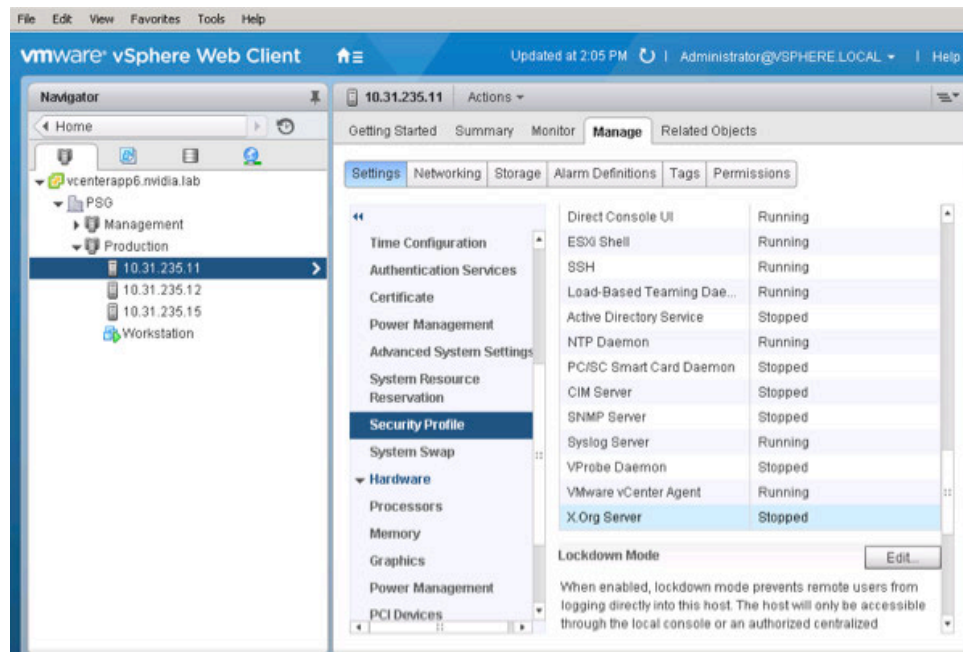
- ▶ Confirm the GPU Installation on page 213
- ▶ Verify the .VIB Installation on page 214
- ▶ Confirm .VIB Loading on page 214
- ▶ Confirm PCI Bus Slot Order on page 215

#### 14.1.1 Check for X.Org Server Issues

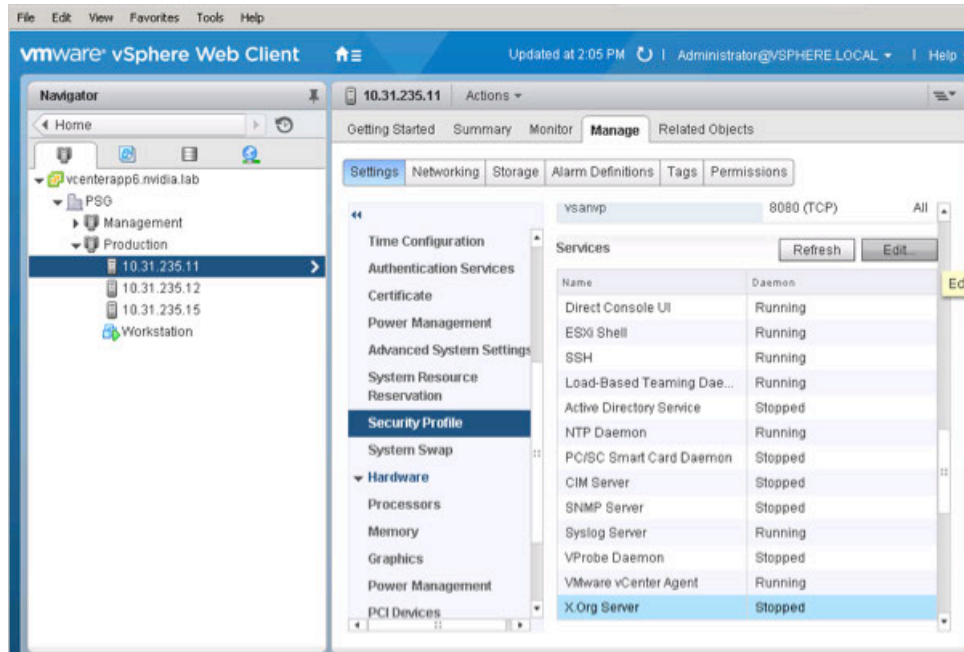
If vGPU-enabled virtual machines fail to start, confirm that the X.Org server is functioning, as this is a fundamental service and necessary for vGPU. You can do this via the web UI of the vSphere Web Client, or via SSH to that vSphere host.

### 14.1.1.1 Managing X.Org Server via the Web Client

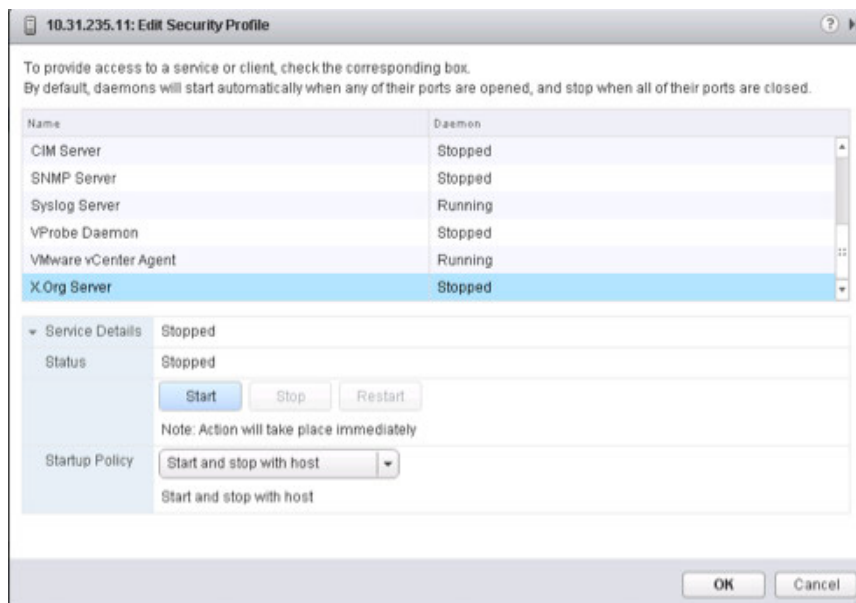
1. Using the VMware vSphere Web Client, browse to the host in question via the menu on the left. From Home, click Hosts, then drill down and single click on a specific host. Now using the view on the main window to the right, click the Manage tab, then the Settings sub-tab, then scroll down then menu to the Security Profile section as shown below. On the Security Profile list, scroll down to the Services section, look for X.Org Server:



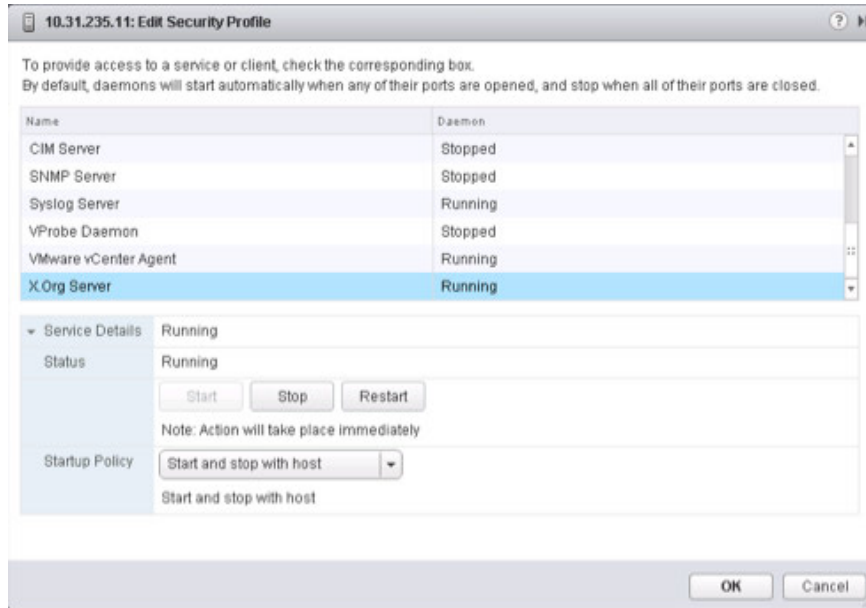
2. In the Services section you can see the current reported status of the X.Org Server service, to change or restart it single click on X.Org Server, then click Edit:



3. The service edit window appears, showing current reported status and allowing you access to starting, stopping, restarting, and managing service behavior on server boot. For a vGPU host you want the service to start and stop with the host. In the example below we show the service as stopped, click Start:



4. The window will refresh and the service should start.



5. Check that your vGPU guests can now start.

- Managing X.Org via CLI on page 215
- Check NVIDIA-SMI on page 218

## 14.1.2 Confirm the GPU Installation

Run the following command on the vSphere host to confirm that the graphics adapter has been physically installed correctly, and that vSphere is aware of the device:

```
$ lspci | grep -i display
```

Output should look similar to the following:

```
0000:09:00.0 Display controller: NVIDIA Corporation NVDIAGRID K2 [vmgfx0]
0000:0a:00.0 Display controller: NVIDIA Corporation NVDIAGRID K2 [vmgfx1]
0000:0d:00.0 Display controller: Matrox Electronics Systems Ltd. MGA G200e
[Pilot] ServerEngines (SEP1)
0000:85:00.0 Display controller: NVIDIA Corporation NVDIAGRID K2 [vmgfx2]
0000:86:00.0 Display controller: NVIDIA Corporation NVDIAGRID K2 [vmgfx3]
```

In this example, the bottom two devices **85:00.0** and **86:00.0** are associated with one of the two K2 cards.

Run the following command to list details about the GPUs listed above:

```
$ esxcli hardware pci list -c 0x0300 -m 0xff
```



You should see output similar to the following for each of the device class **0x300 (Display)**:

```
0000:85:00.0
Address: 0000:85:00.0 Segment: 0x0000
Bus: 0x85 Slot: 0x00 Function: 0x0
VMkernel Name: vmgfx2
Vendor Name: NVIDIA Corporation Device Name: NVIDIAGRID K2 Configured Owner:
Unknown Current Owner: VMkernel
Vendor ID: 0x10de Device ID: 0x11bf SubVendor ID: 0x10de SubDevice ID: 0x100a
Device Class: 0x0300
Device Class Name: VGA compatible controller Programming Interface: 0x00
Revision ID: 0xa1 Interrupt Line: 0x0b IRQ: 11
Interrupt Vector: 0x3e PCI Pin: 0x00
Spawned Bus: 0x00 Flags: 0x0201 Module ID: 18 Module Name: nvidia Chassis: 0
Physical Slot: 4294967295
Slot Description: Chassis slot 5; function 0; relative bdf 01:00.0
Passthru Capable: true Parent Device: PCI 0:132:8:0
Dependent Device: PCI 0:133:0:0 Reset Method: Bridge reset
FPT Sharable: true
```

### 14.1.3 Verify the .VIB Installation

Run the following command using a shell on the host server to confirm that the vib is installed:

```
$ esxcli software vib list | grep NVIDIA
```

If the vib is installed, then the output should look something like this:

```
NVIDIA-vgx-VMware_vSphere_6_Host_Driver 340.49-1OEM.600.0.0.1951118
NVIDIA
VMwareAccepted 2014-10-06
```

### 14.1.4 Confirm .VIB Loading

To confirm that the NVIDIA module has been loaded, run the following command:

```
$ esxcfg-module -l | grep nvidia
```

The result should be:

```
nvidia 4 10576
```

If there is no output, manually load the module by issuing the following command:

```
$ esxcli system module load -m nvidia
```

You can verify that the module loaded using the following command:

```
$ cat /var/log/vmkernel.log | grep NVRM
```

Include any NVRM specific output from `/var/log/vmkernel.log` in any support requests regarding module loading errors.



The `vmkernel.log` should be one of the first places you look when troubleshooting vGPU issues.

## 14.1.5 Confirm PCI Bus Slot Order

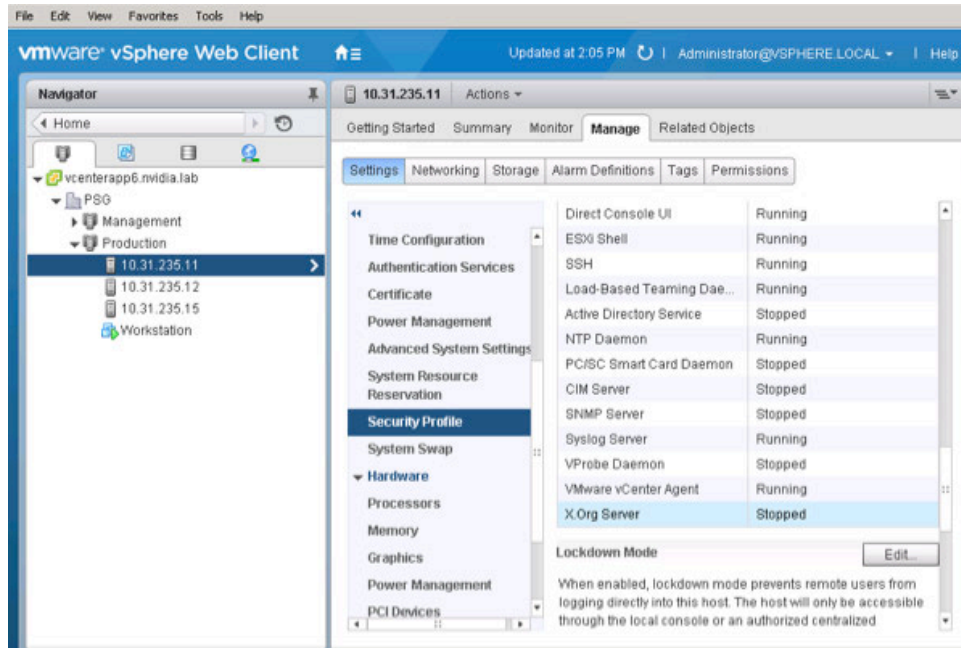
If you installed a second lower-end GPU in the server, it is possible that the order of the cards in the PCIe slots will choose the higher-end card for the vSphere console session. If this occurs, either swap the two GPUs between PCIe slots or change the Primary GPU settings in the server BIOS.

## 14.1.6 Check for X.Org Server Issues

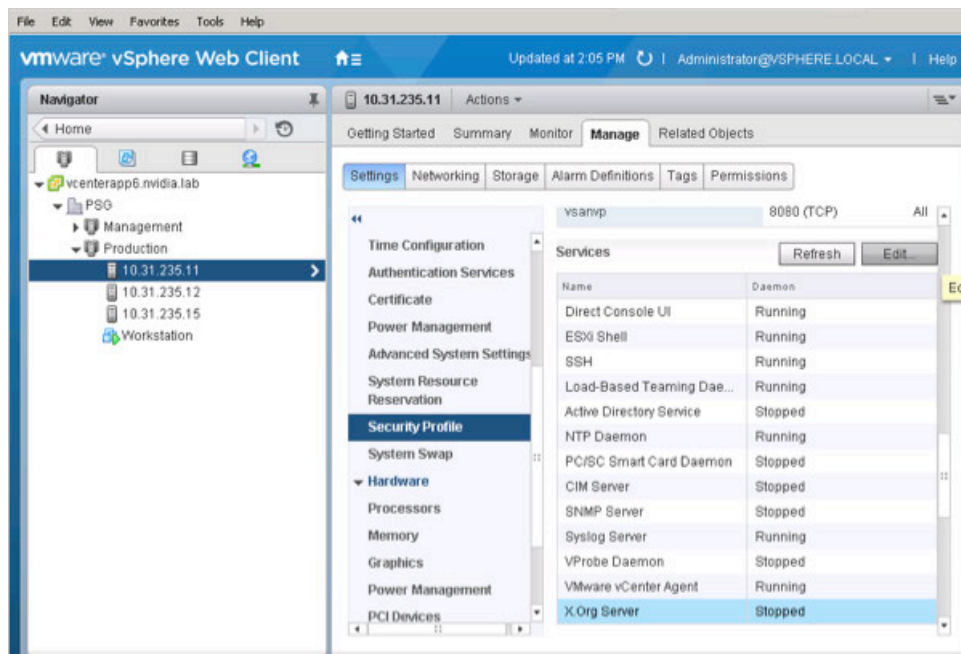
If vGPU-enabled virtual machines fail to start, confirm that the X.Org server is functioning, as this is a fundamental service and necessary for vGPU. You can do this via the web UI of the vSphere Web Client, or via SSH to that vSphere host.

### 14.1.6.1 Managing X.Org Server via the Web Client

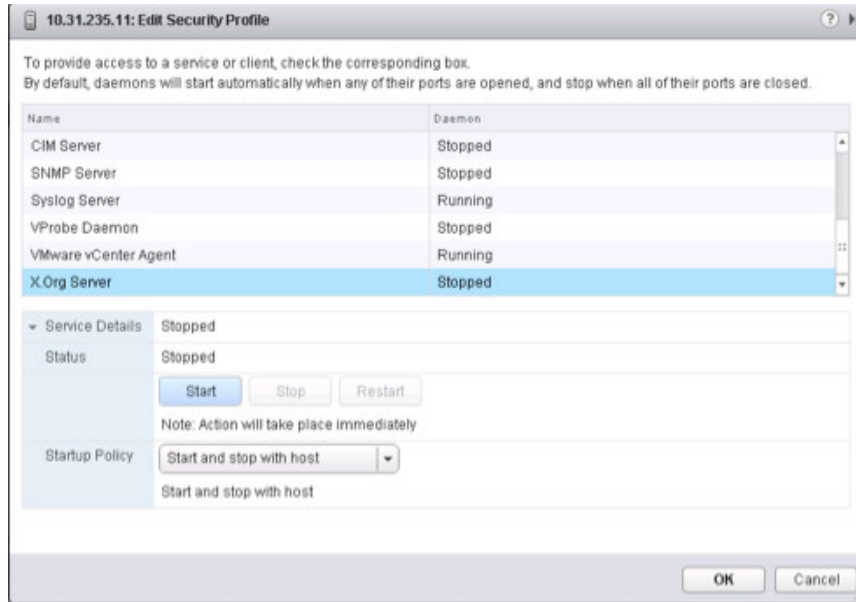
6. Using the VMware vSphere Web Client, browse to the host in question via the menu on the left. From Home, click Hosts, then drill down and single click on a specific host. Now using the view on the main window to the right, click the Manage tab, then the Settings sub-tab, then scroll down then menu to the Security Profile section as shown below. On the Security Profile list, scroll down to the Services section, look for X.Org Server:



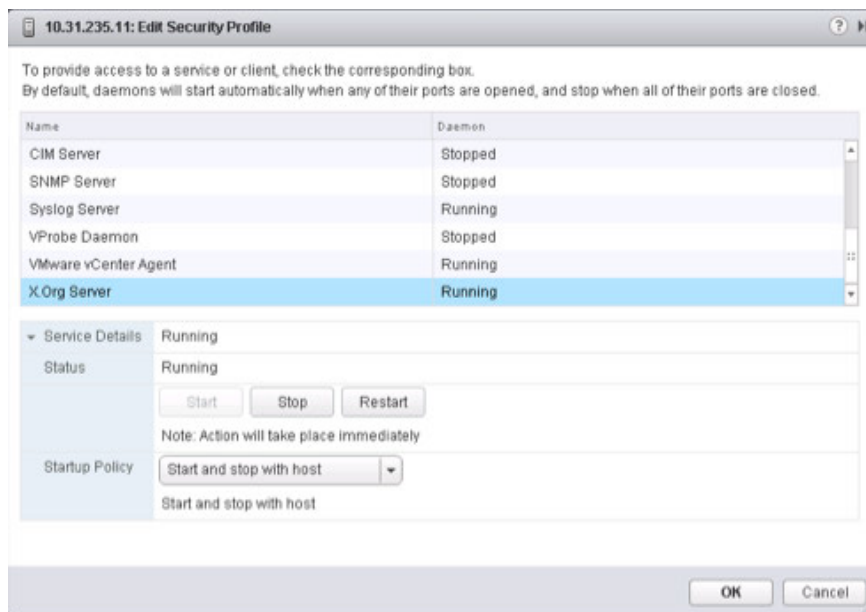
7. In the Services section you can see the current reported status of the X.Org Server service, to change or restart it single click on X.Org Server, then click Edit:



8. The service edit window appears, showing current reported status and allowing you access to starting, stopping, restarting, and managing service behavior on server boot. For a vGPU host you want the service to start and stop with the host. In the example below we show the service as stopped, click Start:




- The window will refresh and the service should start.



- Check that your vGPU guests can now start.

### 14.1.6.2 Managing X.Org via CLI

- Using SSH, connect to the host running vGPU and log in.

 PuTTY is a useful Windows based tool to gain SSH access to a host.

## 2. Check the status of X.Org Server:

```
$ /etc/init.d/xorg status
```

If the X.Org server is operating correctly, the system displays the following output:

```
Xorg0 started  
Xorg1 started  
Xorg2 started  
Xorg3 started
```

If the X.Org server is not running, the system displays the following output:

```
Xorg is not running
```

## 3. Start the X server using the following command:

```
$ /etc/init.d/xorg start
```

The system should return the following messages:

```
Xorg0 started  
Xorg1 started  
Xorg2 started  
Xorg3 started
```

## 4. To troubleshoot an X.Org startup issue, examine the log file for NVIDIA- and/or GPU-related message using the following command:

```
$ cat /var/log/Xorg.log | grep -E "GPU|nv"
```

## 14.1.7 Check NVIDIA-SMI

The NVIDIA System Management Interface (NSMI) is the primary tool to see how much of each GPU is in use when using the NVIDIA driver. To see data about the physical card, run NSMI on the host by issuing the following command in an SSH session:

```
$ nvidia-smi
```

This shows various details of GPU status and usage at the time the command is issued. (The data display is not dynamically updated).

The system returns output similar to the following:

```
+-----+
| NVIDIA-SMI 340.49      Driver Version: 340.49   |
+-----+-----+
| GPU Name   Persistence-M | Bus-Id Disp.A | Volatile Uncorr. ECC |
| Fan  Temp  Perf  Pwr:Usage/Cap| Memory-Usage | GPU-Util  Compute M. |
+-----+-----+-----+-----+-----+
|
|   0   GRID K2
|N/A 52C    P8      Off|0000:09:00.0 Off|
30W / 117W |917MiB/4095MiB |
7%    Off |
Default |
+-----+-----+-----+-----+
|   1   GRID K2    Off|0000:0A:00.0 Off|          Off |
| N/A 43C    P0      50W / 117W |11MiB/4095MiB      |          0%    Default |
+-----+-----+-----+-----+
|   2   GRID K2    Off|0000:85:00.0 Off|          Off |
| N/A 42C    P0      51W / 117W|11MiB /4095MiB |    0%    Default |
+-----+-----+-----+-----+
|   3   GRID K2    Off|0000:86:00.0 Off|          Off |
| N/A 37C    P0      39W / 117W| 11MiB /4095MiB |    0%    Default |
+-----+-----+-----+-----+
|
+-----+
| Compute processes:      GPU Memory |
| GPU-PID  Process name Usage |
+-----+-----+-----+
|   0      37336  Win7-c01   896MiB |
+-----+-----+-----+-----+-----+
+-----+
```



The **Volatile GPU-Util** metric is the most meaningful for troubleshooting, which shows the percentage of the cores on each GPU that are busy at that point in time. This metric can help troubleshoot performance problems, such as by helping you determine whether a GPU is being overloaded.

NSMI requires CPU and other system resources. Repeated loading and running of this command can cause a reduction in performance. Instead use the loop command by adding a **-l** to the command, such as **# nvidia-smi -l**

If you do not specify a delay value, then NSMI will refresh every five seconds. See the NSMI documentation for further usage information.

## 14.1.8 Resolving Black Screen Errors

This issue may occur with high-resolution displays or multi-monitor configurations. Use the following procedure to correct this issue:

1. Open vCenter.
2. Select the **Settings** tab for the virtual machine.
3. Select the video card.
4. Select **Specify custom settings**.
5. Adjust the video memory value higher (such as 32 MB, 64 MB, or 128 MB), as needed; see the Video Memory Calculator for recommended settings.

## 14.1.9 Multi-monitor Display Issues

Some older GRID K1 and GRID K2 BIOS do not support multi-monitor mode. Contact the vendor for updated BIOS and updating instructions.

## 14.2 ENABLING VM CONSOLE VNC ACCESS

Enabling VNC support in the virtual machine will negatively impact performance and should only be used for troubleshooting driver or Horizon connection issues when using vGPU within the virtual machine.

To enable VNC access for the virtual machine console, add the following to the virtual machine's .VMX file:

```
RemoteDisplay.vnc.enabled = TRUE
RemoteDisplay.vnc.port = 5901
RemoteDisplay.vnc.password = your-password
```

You will need to either manually open the port(s) in the virtual machine's firewall settings or disable it completely.



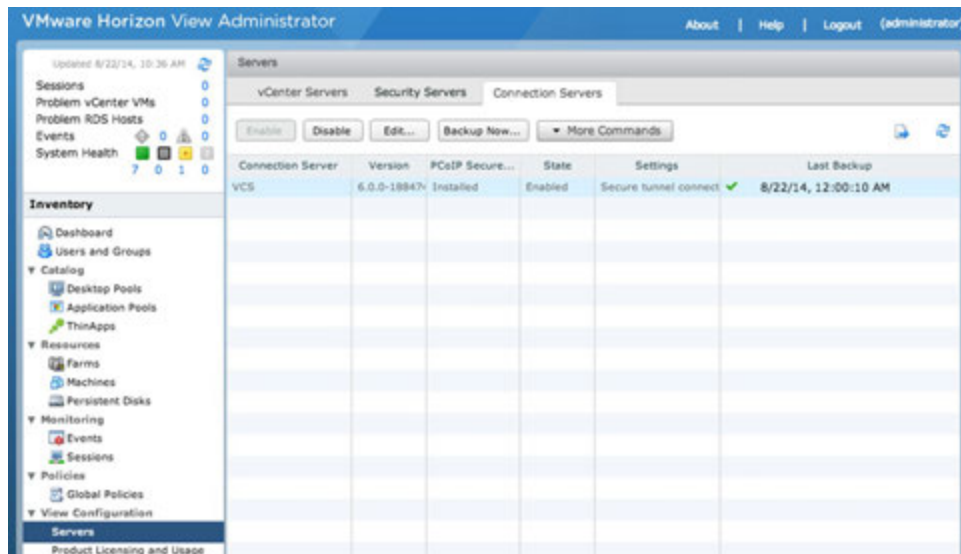
**CAUTION:** THESE INSTRUCTIONS ASSUME THAT THE VM IS BEING USED AS A PROOF-OF-CONCEPT ONLY AND THAT DISABLING THE FIREWALL WILL THEREFORE POSE ONLY A MINIMAL SECURITY BREACH. ALWAYS FOLLOW YOUR ESTABLISHED SECURITY PROCEDURES AND BEST PRACTICES WHEN SETTING UP SECURITY FOR A PRODUCTION MACHINE OR ANY ENVIRONMENT THAT CAN BE ACCESSED FROM OUTSIDE YOUR NETWORK.

## 14.3 JOINING AN ENDPOINT TO THE DOMAIN

If the endpoint is not joined to the domain, change the Horizon connection server settings to the IP address of the server (as opposed to the DNS name of the server), as follows:

1. Select the server to edit in the VMware Horizon Client.
2. Enter your username and password in the displayed pop-up.
3. Select **Continue** to display an alert popup with the following message:  

Error: Unable to resolve server address: nodename nor servname provided, or not known.
4. Select **OK** to continue to the Horizon interface.
5. Select **Servers** in the Horizon interface,
6. Select the server to modify.
7. Select **Edit** to display the *Edit Connection Server Settings* window.



8. Change the hostnames to IP addresses in the **External URL** and **Blast External URL** fields.
9. Select **OK** to return to the Horizon interface.



Edit Connection Server Settings

General Authentication Backup

**Tags**

Tags can be used to restrict which desktop pools can be accessed through this Connection Server.

Tags:  Separate tags with ; or ,

**HTTP(S) Secure Tunnel**

☒ Use Secure Tunnel connection to machine ?

External URL:  Example: https://myserver.com:443 ?

**PCoIP Secure Gateway**

☐ Use PCoIP Secure Gateway for PCoIP connections to machine

PCoIP External URL:  Example: 10.0.0.1:4172 ?

**Blast Secure Gateway**

☒ Use Blast Secure Gateway for HTML access to machine ?

Blast External URL:  Example: https://myserver.com:8443 ?

OK Cancel

## 14.4 FILING A BUG REPORT

When filing a bug or requesting support assistance from NVIDIA, it is critical to include information about the environment, so that the technical staff that can help you resolve the issue. Include in this information details on the host and virtual machine builds, software versions for host and virtual machines, the hardware, the impacted applications (with versions, patch levels, etc.) with screenshots or similar, and any service ticket numbers or similar help requests with other vendors.

NVIDIA includes the `nvidia-bug-report.sh` script within the `.vib` installation package to help collect and package some of this critical information. The script collects the following information:

- ▶ VMware version
- ▶ X.Org log and configuration
- ▶ PCI information
- ▶ CPU information
- ▶ GPU information
- ▶ **esxcfg** information for PLX devices
- ▶ **esxcfg** information for GPU devices
- ▶ VIB information
- ▶ NVRM messages from `vmkernel.log`
- ▶ System **dmesg** output
- ▶ Which virtual machines have vGPU or vSGA configured
- ▶ NSMI output

When running this script:

- ▶ You may specify the output location for the bug report using either the `-o` or `-output` switch followed by the output file name. If you do not specify an output directory, the script will write the bug report to the current directory.
- ▶ If you do not specify a file name, the script will use the default name `nvidia-bug-report.log.gz`.
- ▶ If the selected directory already contains a bug report file, then the script will change the name of that existing report file to `nvidia-bug-report.log.old.gz` before generating a new `nvidia-bug-report.log.gz` file.

To collect a bug report, issue the command:

```
$ nvidia-bug-report.sh
```

The system displays the following message during the collection process:

```
nvidia-bug-report.sh will now collect information about your system and  
create the file 'nvidia-bug-report.log.gz' in the current directory. It  
may take several seconds to run. In some cases, it may hang trying to  
capture data generated dynamically by the vSphere kernel and/or the  
NVIDIA kernel module. While the bug report log file will be incomplete  
if this happens, it may still contain enough data to diagnose your  
problem.
```

Be sure to include the **nvidia-bug-report.log.gz** log file when reporting problems to NVIDIA.

# Chapter 15.

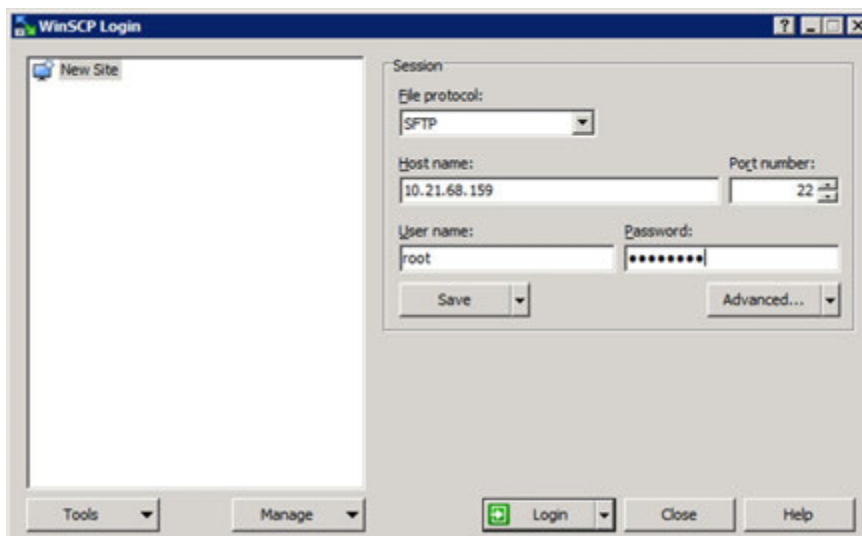
## USING WINSCP

This section describes how to upload a .VIB file using WinSCP. Before doing this:

- ▶ Ensure that SSH is enabled on vSphere.
- ▶ Download and install WinSCP on a Windows PC that has network connectivity to your vSphere host.

Use the following procedure to upload a .VIB file using WinSCP:

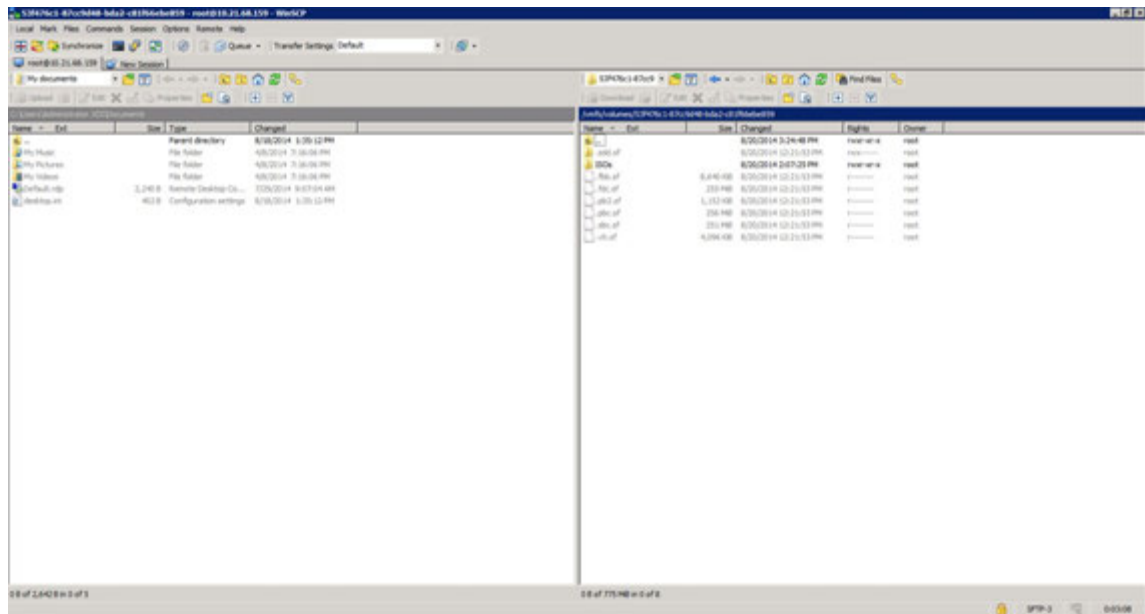
1. Start WinSCP to display the Login screen.
2. Enter the connection details required to connect to the vSphere host.
3. Select **Login** to display the *WinSCP Login* window.



If this is your first time connecting to this server, a warning dialog will appear asking

you to confirm the connection.

4. Navigate to the local folder containing the .VIB file that you want to upload to the vSphere host once the connection is established. Use the left pane of the WinSCP interface.
5. Navigate to a data store you want to upload the .VIB file to using the right pane of the WinSCP interface.



6. Right-click the .VIB file and select **Upload** to upload the file to the host.

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