

Dell EMC Ready Solutions for VDI:

Geographic Information Systems with Esri ArcGIS Pro on Dell Technologies Virtual Desktop Infrastructure Reference Architecture Guide

Abstract

This reference architecture guide describes technical considerations and best practices for the design and deployment of Esri's ArcGIS Pro software on Dell Technologies virtual desktop infrastructure (VDI) with NVIDIA virtual GPUs, using sizing guidance and baseline performance information from NVIDIA.

Dell Technologies Solutions

Notes, cautions, and warnings

 **NOTE:** A NOTE indicates important information that helps you make better use of your product.

 **CAUTION:** A CAUTION indicates either potential damage to hardware or loss of data and tells you how to avoid the problem.

 **WARNING:** A WARNING indicates a potential for property damage, personal injury, or death.

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Executive summary

Topics:

- [Business challenge](#)
- [Environment overview](#)
- [Virtual workstations](#)
- [Document purpose](#)
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- [We value your feedback](#)

Business challenge

Given that requirements and behaviors vary in relation to how users use software, it is critical that appropriate and optimum hardware configurations are tailored to meet these various needs. Software solutions such as Geographic Information Systems (GIS) are used across many industries and enable users to produce cartographic maps, to create 2D and 3D visualizations, and to perform geographic analysis. Depending on the GIS users' requirements, computing requirements can vary greatly. For example, rendering 3D geographic scenes may require dedicated graphics resources, as distinct from the AI Deep Learning Compute resource requirements for object detection inferencing.

GIS software is often considered business-critical for the environments it runs in. Running business-critical software on virtualized platforms can lead to positive benefits, both tangible and intangible. These benefits include the ability to work or learn from anywhere, a better return on infrastructure investment, a quicker time to market with faster software development life cycles, the ability to dynamically meet the development requirements of GIS users, and more favorable user experiences.

Esri is the long-established leader in the GIS field, and their ArcGIS Pro software is a powerful framework for gathering, managing, and analyzing all kinds of geographic data.

Environment overview

With the changing dynamics of the modern-day workforce, it has become challenging for IT teams to manage professional graphics platforms typically running on physical workstations.

Traditionally, designers and engineers in the cartographic and mapping industry use high-end physical workstations. IT teams in these organizations find the deployment, upgrading, and maintenance of these workstations difficult and time-consuming. It is often challenging for IT to ensure interoperability among different components in a physical workstation with multiple ArcGIS software versions.

Virtual desktop infrastructure (VDI) with virtual workstations presents an opportunity to overcome many of the challenges involved in IT management and maintenance, collaboration, security, and flexibility. Virtualization enables IT teams to deploy and present multiple virtual workstations to a user's endpoint device. The virtual workstations are in a data center that IT can manage and maintain centrally. Upgrading operating systems and applications as well as applying security patches is easier. Also, if an outage occurs, virtual workstations can be recovered more quickly than physical workstations.

Virtualization is used in many industries and sectors such as oil and gas, utilities, and government agencies. Virtualized ArcGIS Pro instances are available in both on-premises and cloud-based offerings. ArcGIS Pro delivers exceptional user experience and provides the full range of functionality in virtualized environments using Dell Technologies PowerEdge servers and NVIDIA virtual GPU technology, wherever the user may be.

ArcGIS use cases typically require visualization of complex datatypes, which includes complex vector data, aerial photography, and voxel and scene layers. Virtualized instances of ArcGIS Pro with VDI technologies provide users with a large range of tools to apply complex spatial and raster analytics on geographic datasets.

As the volume and resolutions of spatial data continue to increase, so does the IT administrative burden. Dell Technologies PowerEdge servers or VxRail hyperconverged infrastructure combined with NVIDIA's vGPU technology provide a stable, robust ArcGIS Pro virtualization solution designed to meet the increasing needs of mobile users. Using this solution, IT departments

can reduce costs and administration, increase provisioning times and security, and deliver high-quality GPU-enhanced user experiences.

Virtual workstations

Dell EMC Ready Solutions for VDI offer virtual workstation solutions that provide performance and experience levels that meet or exceed those of physical workstations. The solution combines best-in-class technologies from Dell Technologies, VMware, and NVIDIA. The virtual workstations run on industry-leading Dell EMC VxRail hyperconverged infrastructure (HCI) and PowerEdge servers.

The following table shows the benefits of virtual workstations:

Table 1. Virtual workstation benefits

Feature	Benefit
Centralized management	With faster provisioning of virtual workstations the timeline of projects is reduced. IT can focus instead on issues that are more important to the business while preventing and managing threats and vulnerabilities efficiently.
Ease of maintenance	Recovery of virtual workstations more quickly if there is an outage compared to a physical workstation. Less hardware to manage means reduced maintenance.
Ease of access	Virtual workstations located in the data center, unlike physical workstations that are typically outside the data center network. Access to large datasets using virtual workstations from global, mobile, or third-party users requires less network traffic as only pixel streams from workstation displays are transmitted to end-point devices over the network.
Accelerated time to market (TTM)	Improved employee productivity through ease of access to graphics-enhanced applications.
Flexible workplace	Ability to work from multiple devices and locations combined with freedom from being tethered to physical workstations.
Secure your IP	Secure intellectual property within the perimeter of your organization. Virtual workstations reside in the data center and only the encrypted pixel stream from their displays travel outside the data center perimeter.
Improved version control	Centralized data eliminates the need to synchronize the distributed datasets. Syncing issues are reduced and everyone is working on the same up-to-date model.
Easy lifecycle management	Virtual workstation solutions support vMotion, which enables migration between hardware. Ability to perform maintenance on hardware and workstations without affecting production hours.

Document purpose

This document describes the business challenge, approach, and benefits of implementing an efficient virtual workstation infrastructure for working with GIS workloads. The guide describes the benefits of using an NVIDIA graphics-enhanced Dell Technologies virtual workstation running Esri ArcGIS Pro software, and provides guidance for configuring VMware Horizon virtual workstations on Dell Technologies hardware. It uses the performance testing carried out in the [NVIDIA Quadro Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#) to prescribe several Dell EMC solution architectures tailored for differing GIS market segments. Various technical considerations, including GPU and storage options, are discussed in the context of this reference architecture.


Audience

This document is intended for decision-makers, managers, architects, developers, and technical administrators of IT environments in the GIS industry who want to understand Dell Technologies virtual workstation solutions. Readers should have some knowledge of Dell EMC VxRail hyperconverged infrastructure, PowerEdge servers, Esri ArcGIS Pro software, NVIDIA GPU technologies, and VMware Horizon virtualization.

We value your feedback

Dell Technologies and the authors of this document welcome your feedback on the solution and the solution documentation. Contact the Dell EMC Ready Solutions for VDI team by [email](#) or provide your comments by completing our [documentation survey](#).

Authors: The Dell EMC Ready Solutions for VDI team

 **NOTE:** This website provides additional documentation for VDI Ready Solutions from Dell Technologies: [Virtual Desktop Infrastructure](#).

Solution architecture

Topics:

- [Overview](#)
- [Key components](#)
- [System configurations](#)

Overview

This section describes the key hardware and software components in the solution, and the recommended configurations.

We provide design recommendations for two hardware architectures:

- VxRail hyperconverged infrastructure
- Three-tier storage configurations based on PowerEdge servers

This section describes both VxRail and PowerEdge components. Hyperconverged and three-tier design recommendations based on each of these components are presented later in the document.

Key components

This section describes the key hardware and software components of the solution.

Esri ArcGIS portfolio

The Esri technology portfolio of geospatial information and mapping products is very broad. Some of the offerings are described below. This Dell EMC Ready Solution focuses on ArcGIS Pro.

ArcGIS Online

ArcGIS Online is a cloud-based WebGIS platform that is managed by Esri. It includes mapping solutions, analysis tools, and numerous application modules.

ArcGIS Enterprise

ArcGIS Enterprise is a hybrid cloud-based WebGIS system managed by the customer. It consists of ArcGIS Server, ArcGIS Web Adaptors, ArcGIS Data Store, and Portal for ArcGIS. Optional specialty server roles can be added to extend functionality. It encompasses ArcGIS Online offerings with the additional flexibility to tailor system design and administration offerings to specific organizations' requirements.

ArcGIS Pro

ArcGIS Pro is a Windows application requiring enhanced graphics support. It is similar in computing and graphics requirements to professional AutoCAD applications. Esri ArcGIS Pro is a desktop-based GIS application that allows users to visualize data, run analysis, manage and maintain data, and work with 2D and 3D data. It connects directly to ArcGIS Online by using the ArcGIS Enterprise Portal.

ArcGIS users broadly fall into three usage profiles or personas, which can be described as Fundamental User, Intermediate User, and Advanced User. These categories put common ArcGIS Pro tasks and activities into groups. These range from map visualization and the use of 2D vector data and light editing, to advanced map visualization using complex datatypes such as

raster data and applying advanced spatial analytics with geo-processing tools. These three user personas loosely correlate to the amount of CPU and GPU resources required to perform these associated activities.

For more information about user personas, see [User types, roles, and privileges](#).

The following table explains the user personas:

Table 2. User personas

User persona	Typical activities	Licensing
Fundamental User	Interactive map visualization in 2D and 3D, single user data editing and database spatial analysis using vector data, and raster imagery visualization.	GIS Professional Basic
Intermediate User	All capabilities of the Basic license level with the addition of multi-user editing and database management with larger datasets, and higher-end spatial and raster analysis tools.	GIS Professional Standard
Advanced User	All the capabilities of the Standard license level with the addition of high-end cartography and the full range of ArcGIS Pro's spatial analysis capabilities.	GIS Professional Advanced

NOTE: Esri ArcGIS Pro is the focus of this reference architecture. Configuring ArcGIS Pro in a virtual workstation environment enhances flexibility, improves manageability for IT, and further expands the variety of platform choices available to users.

Dell EMC VxRail hyperconverged infrastructure

Dell EMC VxRail hyperconverged infrastructure (HCI) use VMware vSAN technology, running on Dell EMC PowerEdge servers, and is further enabled by Dell EMC management software. VxRail hyperconverged infrastructure simplifies IT operations and provide a highly scalable and agile VDI environment for running your virtual workstations. It is an integrated, preconfigured, turn-key system that makes the deployment and configuration of virtual workstations easier and faster. The infrastructure is sustained as a single product and comes with automated life cycle management capabilities. Upgrades and patches are nondisruptive.

The VxRail V Series is optimized for VDI workloads. It supports GPU hardware configurations that are capable of running the graphics-intensive applications commonly used in the automotive and manufacturing industries. The models available in the V series are the VxRail V570 (hybrid) and the VxRail V570F (all-flash). The VxRail V570 is a 2U model with a broad range of configuration options. These models are based on PowerEdge R740xd rack servers.

Dell EMC PowerEdge servers

Dell EMC PowerEdge servers provide uncompromising performance with scalable architecture, intelligent automation, and integrated security for your VDI workloads. They are also the foundation for VxRail hyperconverged infrastructure.

A traditional three-tier storage configuration based on PowerEdge servers with several dedicated storage options is presented in subsequent sections.

The PowerEdge R740xd server is the platform of choice for VDI workloads. PowerEdge R740xd rack servers provide a 2U, two-socket platform that is ideal for virtual desktop workloads with GPU configurations. The R740xd server can accommodate two of the Intel Xeon family of scalable processors, each with up to 28 cores. These servers include 2nd Generation Intel Xeon Scalable Processors, providing exceptional performance and scalability. R740xd servers have up to 24 DIMMs and eight PCI Express (PCIe) 3.0-enabled expansion slots.

GPU acceleration

NVIDIA vGPU

NVIDIA RTX Virtual Workstation (vWS) software delivers powerful virtual workstations from data centers to an endpoint device. The vWS software provides easy access to GIS, 3D CAD, and CAE applications in a VDI environment. The ease of accessing datasets enables greater collaboration among professionals in the GIS sector. From an IT standpoint, vWS provides centralized management of virtual workstations and exceptional monitoring features. The following figure shows an NVIDIA vGPU with vWS license selected:

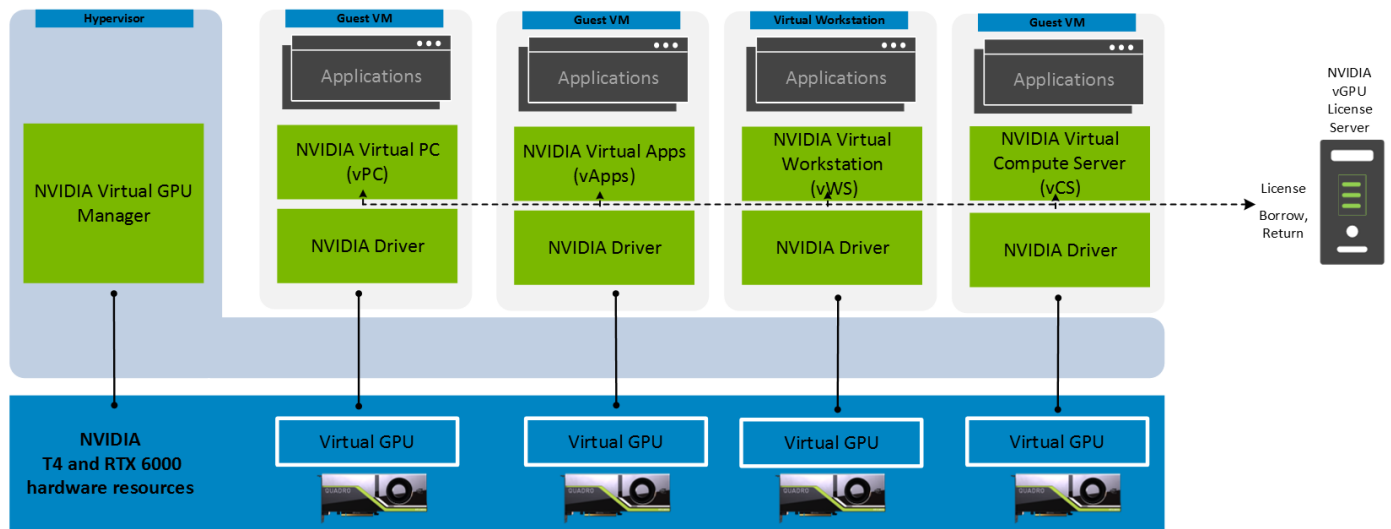


Figure 1. NVIDIA vGPU with vWS license selected

NVIDIA vGPU software creates virtual GPUs that are mapped to underlying physical GPUs. These virtual GPUs are assigned to each virtual workstation. NVIDIA vWS licenses enable the powerful graphics driver for professional 3D applications. The driver, which is installed on each virtual machine (VM) host, enables graphics commands from the VMs to pass to the GPU hardware. vWS comes with multiple profile size options that cater to different use cases and varying graphics requirements. You can select the correct GPU and vGPU profile (frame buffer) size for your professional graphics use cases.

vWS supports applications with the highest resolution graphics and enables professionals to work with multiple 4K, 5K, and 8K displays. vWS software supports up to four 4K displays or two 8K displays, enabling professionals in the GIS sector to work on the details of graphics with ease.

NVIDIA T4 GPU

The NVIDIA T4 is a flexible GPU that serves various workloads. The NVIDIA T4 Tensor Core GPU is based on the Turing architecture and comes with 2,560 CUDA cores and a 16 GB DDR6 memory. The T4 operates at 70 W, providing higher energy efficiency and lower operating costs than its predecessors. It has a single-slot PCIe form factor. You can configure up to six T4s in a single PowerEdge R740xd server. The T4 comes with an enhanced NVIDIA NVENC encoder that can provide higher compression and better image quality with H.264 and H.265 (HEVC) video codecs. The NVIDIA T4 NVENC encoder provides up to 25 percent bit rate savings for H.265 and up to 15 percent bit rate savings for H.264.

RTX 6000 GPU

The NVIDIA RTX 6000 is a powerful GPU that serves various workloads. The RTX 6000 is based on Turing architecture and comes with 4,608 CUDA cores and a 24 GB DDR6 memory. The RTX 6000 operates at 250 W, providing higher energy efficiency and lower operating costs than its predecessors. It has a dual-slot PCIe form factor. You can configure up to three RTX 6000 in a single PowerEdge R740xd server. The RTX 6000 comes with an enhanced NVIDIA NVENC encoder that can provide higher compression and better image quality with H.264 and H.265 (HEVC) video codecs.

The following table maps the referenced NVIDIA GPU cards to the appropriate ArcGIS user persona:

Table 3. User personas mapped to GPUs

Esri ArcGIS Pro user persona	GPU
Fundamental User	T4
Intermediate User	T4
Advanced User	RTX 6000

The user persona information in this table is based on the [NVIDIA Quadro Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#).

VMware Horizon 8

VMware Horizon 8 provides the centralized management, agility, and simplicity that is required for your virtual desktop infrastructure. With Horizon 8, your workstations reside in the data center premises, which makes the provisioning, maintenance, and recovery of virtual workstations easier. Horizon 8 can provision and deliver virtual desktops and applications in a fast, flexible, and personalized manner. It leverages Instant Clones technology for ultrafast provisioning of desktops, App Volumes for real-time application delivery, and Dynamic Environment Manager for contextual policy management to deliver an experience with the simplicity of nonpersistent management.

When implementing VDI using Horizon 8, the intellectual property (IP) of your organization is secure inside your data center premises. A lightweight Horizon 8 client is installed on the end-point devices that communicates with virtual workstations in the data center. The Horizon 8 client is compatible with most devices on the market. It provides flexibility for employees working from home, as well as contractors and partners working from any device anywhere, thus increasing collaboration and productivity.

For graphics-accelerated VDI workloads, Dell Technologies recommends using the Blast Extreme Display protocol, which provides an enhanced remote session experience for professional graphics applications, even in a low latency network. The Blast Extreme protocol supports the H.264 and H.265 codecs, which can encode the graphics content from a virtual workstation display. NVIDIA T4 GPUs come with an advanced NVENC encoder. This encoder can offload H.264 or H.265 encoding from server processors, providing lower latency and better performance for the professional graphics applications that are used in the GIS sector.

System configurations

Ready Solutions for VDI-optimized configurations for virtual workstations on VxRail

Dell EMC Ready Solutions for VDI offers virtual workstation solutions for running the professional graphics applications that are used in the GIS sector. The solution configuration based on the VxRail HCI platform is recommended for running professional graphics applications such as Esri ArcGIS Pro as well as Revit, Inventor, 3DS Max, and AutoCAD.

The compute layer uses VxRail V570F hyperconverged infrastructure, which is VDI-optimized and offers the highest processor speeds and graphics capability. The storage layer is powered by VMware vSAN software-defined storage technology. The network layer consists of Dell EMC PowerSwitch S5248 (25 GbE ToR switches). Virtual workstations run on a VMware ESXi hypervisor. VMware Horizon 8 is the virtual desktop brokering software. NVIDIA vGPU vWS virtualizes the GPU hardware to provide virtual GPUs for each virtual workstation.

For graphics-intensive desktop deployments, we recommend the VDI-optimized 2U servers that support GPU hardware. We have designated common configurations as Management-optimized and Density-optimized Virtual Workstation Host. These designations are referenced throughout this document and are outlined in the following table:

Table 4. Common configurations

Configuration	CPU	RAM	Disk	GPU	Description
Management-optimized	2 x Intel Xeon Silver 4214 (12 core @ 2.2 GHz)	192 GB (12 x 16 GB @ 2400 MHz)	4 TB + (Capacity)	None	Offers a scalable and value targeted configuration that meets the required compute and I/O demands
Density-optimized Virtual Workstation Host	2 x Intel Xeon Gold 6254 (18 core @ 3.1 GHz)	384 GB-768 GB @ 2933 MHz	8 TB + (Capacity)	Up to 3 x full length, dual width (FLDW) (for example, the RTX 6000) Up to 6 x full length, single width (FLSW) (for example the T4)	Offers even higher performance at the tradeoff of user density. Typically for high-end graphics workloads.

For more information, see the [VMware Horizon on VxRail and vSAN Ready Nodes Design Guide](#).

The following figure shows an overview of the solution architecture of the virtual workstation environment on a VxRail platform:

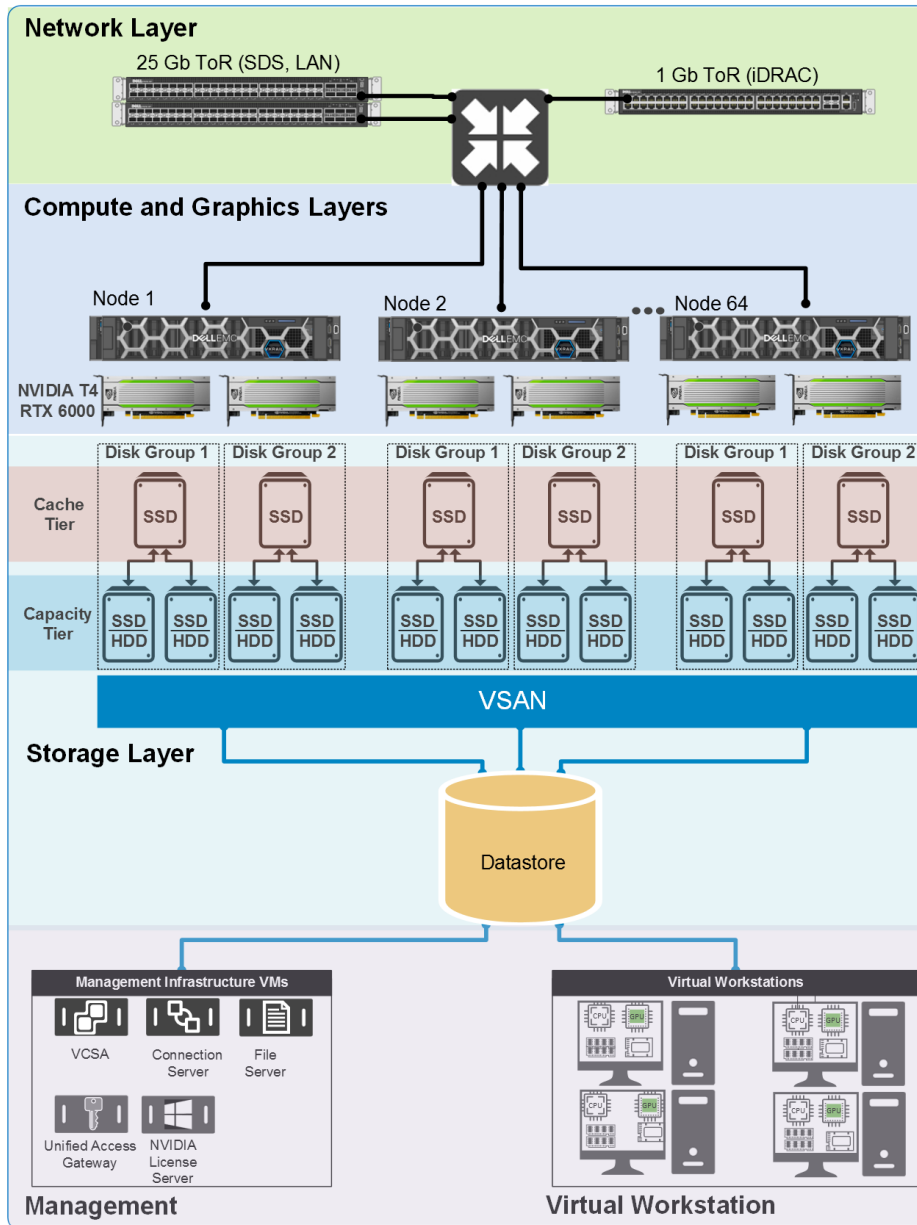


Figure 2. Virtual workstation on VxRail solution architecture

See [Table 8](#) for indicative virtual workstation density scalability.

VMware vSAN software-defined storage

VMware vSAN is available in all-flash or hybrid configurations. After vSAN is enabled on a cluster, all disk devices presented to the hosts are pooled together to create a shared datastore that is accessible by all hosts in that vSAN cluster. You can then create VMs and assign storage policies to them. The storage policy dictates availability and performance. vSAN provides the following configuration options:

- All-flash configuration—Uses flash for both the cache tier and capacity tier to deliver enterprise performance and a resilient storage platform. In this configuration, the cache tier is fully dedicated to writes, allowing all reads to come directly from the capacity tier. The cache device protects the endurance of the capacity tier. All-flash configured solutions enable data reduction features to extend the capacity tier.
- Hybrid configuration—Uses flash-based devices for the cache tier and magnetic disks for the capacity tier. Hybrid configurations are ideal for clients looking for higher volume in the capacity tier. The performance of SSD and magnetic spinning disks is comparable in VDI applications if you use a sufficient number of magnetic spinning disks.

The following table shows the hardware configuration that Dell Technologies recommends for the virtual workstation solution on the VxRail platform:

Table 5. Hardware configuration

Component	Configuration
Memory	384 GB-768 GB (12 x 32 GB, 12 x 64 GB)
Storage adapter	HBA 330
Network	25 GbE
Boot device	BOSS + M.2 SATA SSDs
Cache tier	800 GB WI SAS SSD
Capacity tier	1.92 or 3.84 TB RI SAS or SATA SSD
GPU	6 x T4 GPU or 3 x RTX 6000, depending on the user persona

NOTE: It is important to test your own workloads and datasets. The recommendation provided here is generalized guidance rather than a one-size-fits-all configuration.

The degree to which higher scalability is achieved depends on the typical day-to-day activities of your ArcGIS Pro users, and the concurrent nature or otherwise of their work. Several configuration attributes directly affect density scalability, such as virtual workstation parameters, GPU scheduling policy, and vGPU profile selection. It is recommended that you test and validate the appropriate configuration options to meet the needs of your users.

NOTE: The density numbers provided offer general guidance and are indicative in nature. Individual user circumstances require appropriate validation.

NOTE: The user persona information in the following tables is based on the [NVIDIA Quadro Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#).

The following table shows virtual workstation VM profile configurations:

Table 6. Virtual workstation VM profile configurations

Esri ArcGIS Pro persona			
Workstation host	Fundamental Users	Intermediate Users	Advanced Users
Number of VMs per host	16-24	10-12	6-9
vCPU	6	8	8-12
Memory	8-10 GB	10-16 GB	32-64 GB
vGPU profile	T4-4Q	T4-8Q	RTX 6000-8Q - RTX 6000-12Q ^a
VDI storage	> 250 GB	> 250 GB	> 250 GB

a. With a vGPU profile size of 12 GB, you can have up to 6 concurrent Advanced Users running per VxRail node, based on the sizing recommendations in [Table 7](#).

[Table 7](#) shows the virtual workstation VM configuration that Dell Technologies recommends for the solution based on the NVIDIA Esri sizing guide. This configuration is only applicable to the hardware configuration shown in [Table 6](#). The [Table 7](#) configurations assume a fixed memory per node between 384 GB for Individual Users to 768 GB for Advanced Users, based on the Esri ArcGIS Pro user personas. You can change the memory to a higher or lower value based on the datasets that the application uses. The operating system used by the VMs is Windows 10. The screen resolution is 1920 x 1080p.

Frame buffer or vGPU profile size is a major factor to consider when you size the virtual workstations. Choosing a vGPU profile for the user depends on the type of workflow and the size of the model with which they work. Users with more advanced graphics requirements and larger datasets require a larger frame buffer. For these users, assign a larger vGPU profile that can cater to the frame buffer requirement of the application. To understand the frame buffer requirement, perform appropriate tests in the pilot phase with tools such as GPU Profiler. We recommend that you size the vGPU profiles based your users' workflows. For guidance, see the [NVIDIA Quadro Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#). In general, if an application's utilization of the frame buffer nears 100 percent, assign the next profile size to that user.

You can configure a VxRail V570F with up to six NVIDIA T4 GPUs, providing 96 GB of frame buffer per node, or three NVIDIA RTX 6000 GPUs, providing 72 GB of frame buffer per node.

NOTE: With a vGPU profile size of 12 GB, you can have up to six concurrent Advanced Users running per VxRail node, based on the sizing recommendations in Table 7.

The following table shows VxRail cluster scalability for ArcGIS Pro virtual workstations:

Table 7. VxRail cluster scalability for ArcGIS Pro virtual workstations

Esri ArcGIS Pro persona			
VxRail nodes ^a	Number of Fundamental Users	Number of Intermediate Users	Number of Advanced Users
4	64-96	40-48	24-36
16	256-384	160-192	96-144
32	512-786	320-384	192-288
64	1024-1572	640-768	384-576

a. The recommended minimum VxRail configuration is four nodes.

The following table shows indicative user density on a VxRail node:

Table 8. Indicative user density on a VxRail node

Esri ArcGIS Pro persona			
VxRail node	Number of Fundamental Users	Number of Intermediate Users	Number of Advanced Users
1	16-24	10-12	6-9

NOTE: These density figures were taken from the [NVIDIA Quadro Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#). The density figures provide general guidance and are indicative in nature. Individual user circumstances require appropriate validation.

Ready Solutions for VDI-optimized configurations for virtual workstations on the PowerEdge server and three-tier dedicated storage

Dell EMC Ready Solutions for VDI offers virtual workstation solutions on the PowerEdge server with these dedicated storage solution recommendations:

- PowerStore T
- PowerMax
- PowerScale

The solution configuration that this section describes is recommended for running professional graphics applications including Esri ArcGIS Pro.

NOTE: For small-scale ArcGIS Pro deployments, locally provided PowerEdge storage may prove sufficient for user needs.

The following figure shows an overview of the solution architecture of the virtual workstation environment. The compute tier consists of PowerEdge R740xd servers that can host up to six NVIDIA T4 GPUs or three NVIDIA RTX 6000 GPUs. The storage tier depicted is the PowerStore T appliance, which can be configured with up to four appliances per cluster. The network tier consists of Dell Technologies PowerSwitch S5248-25 GbE ToR switches. Virtual workstations run on a VMware ESXi hypervisor. VMware Horizon 8 is the virtual desktop brokering software. NVIDIA vWS software virtualizes the GPU hardware to provide virtual GPUs for each workstation.

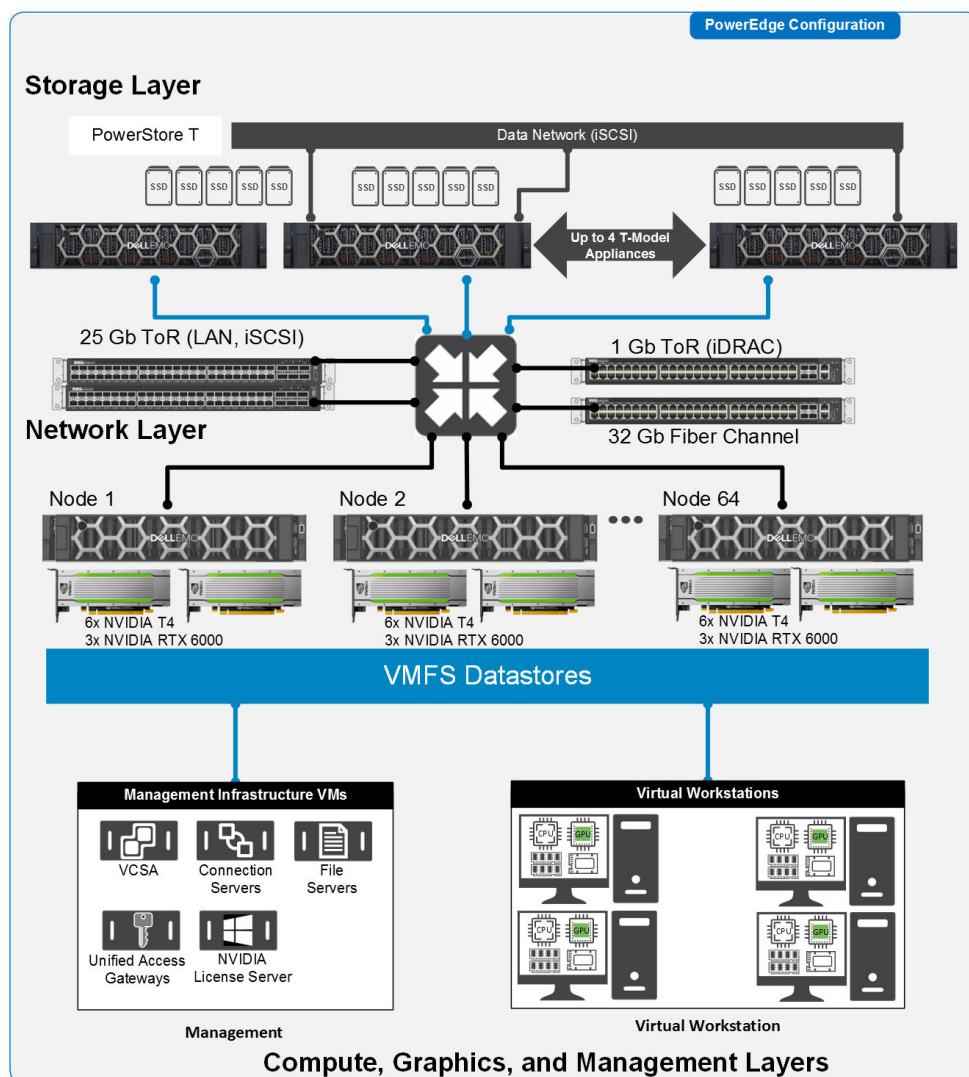


Figure 3. Virtual workstation on PowerStore T solution architecture

The following table shows the recommended hardware configuration for a Dell Technologies virtual workstation with PowerEdge servers and traditional three-tier storage:

Table 9. Hardware configuration

Component	Configuration
Platform	PowerEdge R740xd
CPU	2 x Intel Xeon Gold 6254
Memory	384 GB–768 GB
Storage adapter	Fibre Channel HBA
Network	25 GbE
Boot	BOSS + M.2 SATA
GPU	6 x T4 GPU or 3 x RTX 6000, depending on user persona
Storage	PowerStore T, PowerMax, PowerScale

The degree to which higher scalability is achieved depends on the typical day-to-day activities of your ArcGIS Pro users, and the concurrent nature of their work. Several configuration attributes directly affect density scalability, such as virtual workstation parameters, GPU scheduling policy, and vGPU profile selection. It is recommended that you test and validate the appropriate configuration options to meet the needs of your users.

NOTE: The density numbers provided are general guidance and are indicative in nature. Individual user circumstances require appropriate validation.

See [Table 7](#) for the virtual workstation VM configuration on PowerEdge that Dell Technologies recommends for the solution, based on the referenced NVIDIA Esri sizing guide.

There may be occasions in which three-tier storage is more suitable for your needs than HCI solutions such as VxRail, for example if you already have dedicated three-tier storage. Three-tier storage solutions may also meet additional user requirements by providing flexibility, larger storage capacity, and additional storage services.

In those circumstances, Dell Technologies recommends a range of traditional three-tier storage offerings such as PowerStore T, PowerMax, and PowerScale, each of which is tailored with particular user needs in mind. See the specific product family reference material and the design consideration section of this document for more detail.

The following table shows pertinent GIS storage considerations, such as sufficient storage capacity for increasing high resolution mapping data. However, the table is not intended as an exhaustive list of storage capabilities for each of these storage solutions.

Table 10. PowerEdge three-tier storage recommendations

Solution	Market position	Pertinent storage service	Storage capacity/ scale	Reference
PowerStore T	Mid-range	<ul style="list-style-type: none"> Block and file NVMe support Inline deduplication, platform integrations 	<ul style="list-style-type: none"> Maximum 4 appliances per PowerStore T cluster Up to 2.8 PB per appliance 	PowerStore Family
PowerMax	Top-range	<ul style="list-style-type: none"> Block and file NVMe support Mission critical availability and disaster recovery Up to 350 GB per second sustained bandwidth Inline data deduplication and compression 	<ul style="list-style-type: none"> Scale up and scale out to 4.5 PB of effective capacity 	PowerMax Family

Table 10. PowerEdge three-tier storage recommendations (continued)

Solution	Market position	Pertinent storage service	Storage capacity/ scale	Reference
PowerScale	Mid-top-range	<ul style="list-style-type: none">• Unstructured data• File and object storage, and NVMe support• Multi-protocol support• Performance (up to 250,000 IOPS)• Cloud integration, inline data deduplication and compression	<ul style="list-style-type: none">• 96 to 924 TB in a single 4U chassis• Up to 58 PB raw storage in a single cluster	PowerScale Family

Design validation and considerations

Topics:

- [Esri ArcGIS Pro display configuration](#)
- [Compute layer configuration](#)
- [Storage considerations](#)
- [CPU and GPU utilization](#)

Esri ArcGIS Pro display configuration

By default, the application uses the DirectX rendering engine and limits frames to 60 frames per second. Users may choose to lower rendering detail and anti-aliasing settings to optimize performance on virtual workstation instances. If hardware acceleration is not available, the software reverts to using the CPU for graphics functions, but with much lower performance than if GPU acceleration were available. For more information, see [Set display options](#).

For additional VDI design considerations, see [Delivering ArcGIS Pro Virtually in High Resolution](#).

Compute layer configuration

When configuring a VMware Horizon virtual workstation on Dell Technologies hardware, the Dell EMC Ready Solutions for VDI team recommends that you consider the following factors:

Physical R740xd host considerations

- Set the Hosts BIOS System Profile to "Performance".
- If the ambient temperature is not cool enough, consider changing the iDRAC Thermal Profile to Maximum Performance. This configuration reduces the probability of thermal throttling of the CPU and GPUs. For more information, see the [Integrated Dell Remote Access Controller 9 Version 3.15.15.15 User's Guide](#).
- Size the virtual CPUs of the workstation VMs within the NUMA node boundaries of the physical processors. For more information, see [Virtual Machine vCPU and vNUMA Rightsizing Guidelines](#).
- Choose and set the appropriate GPU scheduler for your workload and use case. The fixed share scheduler option provides the most consistent dedicated performance at all times. The default deployment is the "Best effort" GPU scheduler policy, which typically supports more users per server and provides better TCO per user. Available GPU scheduler options include:
 - Best Effort (Default)
 - Equal Share
 - Fixed Share

For more information, see [NVIDIA's virtual GPU software documentation](#).

- Specific NVIDIA GPU scheduling guidelines are described in the [NVIDIA Quadro Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#). Performance results for both the "Fixed Share" scheduler and the "Best Effort" scheduler options are evaluated, with recommendations based on benchmarking data and customer best practices for Esri ArcGIS Pro deployments. The following figure, which is taken from the NVIDIA sizing guide, shows that when using the best effort GPU scheduling policy, performance for an individual user that shares a GPU with other users is as good as having a dedicated GPU, if the other end-users are not running GPU-intensive tasks in parallel.

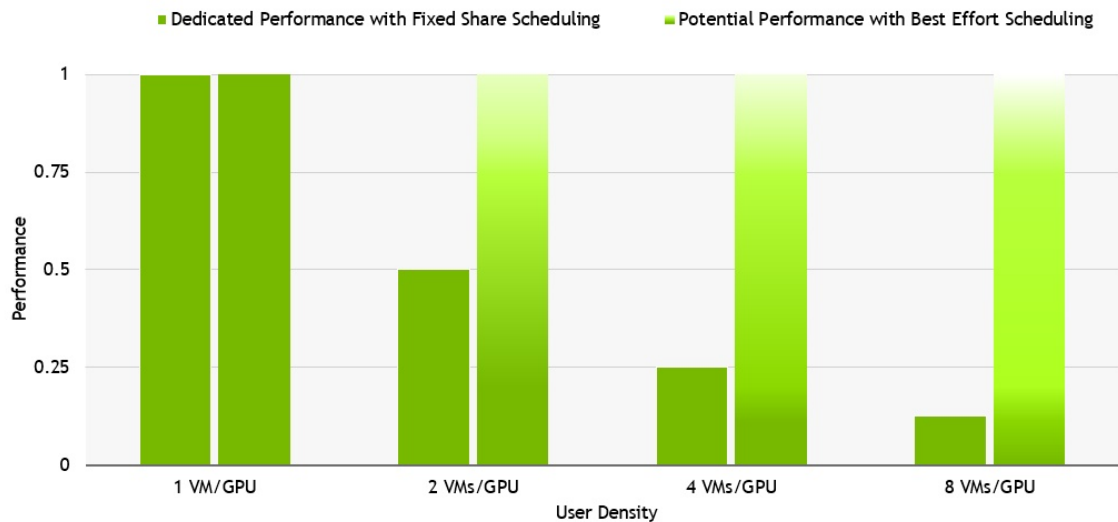


Figure 4. Fixed share scheduling compared with best effort scheduling

VDI display protocol recommendations

While the choice of VDI display protocol is at the user's discretion, at the time of publication Dell Technologies recommends the VMware Blast protocol.

NOTE: The PCOIP protocol was selected for performance testing as described in the [NVIDIA Quadro Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#).

Virtual workstation VM considerations

VMware Blast display protocol

- Set the VMware Horizon Blast Max Frame Rate to 60 using the registry key or GPO. For more information, see [VMware Blast Policy Settings](#).
- Using the VMware Horizon Performance Tracker in the Virtual Workstation VM, ensure that the protocol is Blast and the encoder name is NVIDIA NvEnc H264. The recommended protocol for running graphics workloads in a VMware Horizon environment is Blast Extreme. The following figure shows the settings:

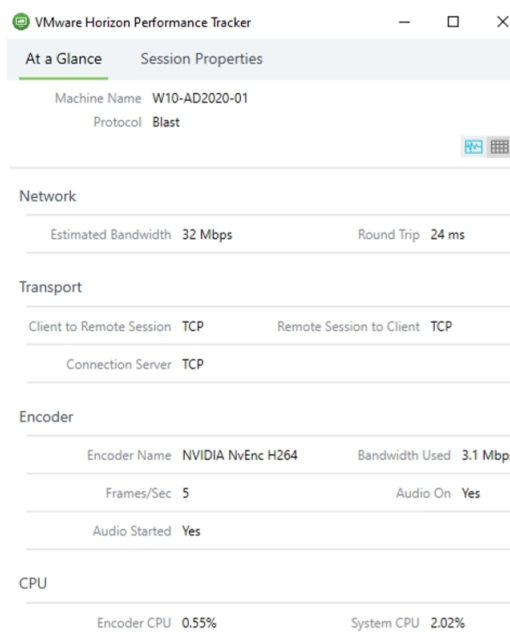


Figure 5. VMware Horizon Performance Tracker settings

- Ensure that the monitor refresh rate is set to 60 Hz in the NVIDIA Control Panel in the virtual workstation VM.

PCoIP

To ease configuration, VMware provides an active directory ADMX template file containing the related PCoIP display protocol settings. See [PCoIP Policy Settings](#).

Settings are segregated into the following categories: PCoIP General settings, PCoIP Clipboard, and Drag and Drop settings, PCoIP Bandwidth settings, PCoIP Keyboard settings, PCoIP Build-to-Lossless Features. The relevant settings for this solution are:

PCoIP general settings:

- Configures PCoIP image quality levels (range 30-100, default 40)—A lower value allows higher frame rates, but with a potentially lower quality display. A higher value provides higher image quality, but with potentially lower frame rates when network bandwidth is constrained. When network bandwidth is not constrained, PCoIP maintains maximum quality regardless of this value.
- Configures frame rate versus image quality preference (range 0-100, default 50)—A higher value (maximum 100) indicates that you prefer high image quality even if the frame rate is choppy. A lower value (minimum 0) indicates that you prefer a fluent experience with aggressive image quality.

PCoIP bandwidth settings:

- Maximum PCoIP Session bandwidth—This setting applies to Horizon Agent and the client. If the two endpoints have different settings, the lower value is used. Setting this value prevents the agent from attempting to transmit at a higher rate than the link capacity, which causes excessive packet loss and a poorer user experience. The default value is 900 Mbps.
- Minimum (Floor) PCoIP Session bandwidth—This setting applies to Horizon Agent and the client, but the setting only affects the endpoint on which it is configured. This setting configures the minimum expected bandwidth transmission rate for the endpoint. The default value is 0, which means that no minimum bandwidth is reserved.

VDI Client Broker

Use the latest version of the VMware Horizon Client. At the time of publication of this document, the latest version was 8.1.0.

Storage considerations

The solution configuration based on the VxRail HCI platform is recommended for running professional graphics applications such as Esri ArcGIS Pro, Revit, Inventor, 3DS Max, and AutoCAD, based on VMware's vSAN storage technology. However, where this storage option is not suitable, for example in instances where file-based storage is favored or larger capacity is required or where there is a customer preference for a three-tier solution, the following alternative storage solutions are recommended:

PowerStore T storage

PowerStore T is a mid-range storage solution. Its features include:

- Block and file storage technologies with NVMe support
- Active/active high availability
- Inline deduplication
- Platform integration with VMware, Kubernetes, Ansible, and REST API
- Scale up and scale out—up to 2.8 PBe per appliance. Maximum of four appliances per PowerStore T cluster.

The recommended model for standard VDI deployments is the PowerStore T 7000 or higher. For more information, see [PowerStore Family](#).

PowerMax storage

PowerMax is a top-tier storage solution. Its features include:

- Block and file storage technologies with NVMe support
- Mission critical availability and disaster recovery technology
- Industry-leading deduplication and compression methods
- Scale up and scale out (consists of modular building blocks called “bricks”)
 - PowerMax storage arrays can scale up and scale out. Customers can scale up by adding Flash Capacity Packs. For the PowerMax 2000 storage array, Flash Capacity Packs are available in increments of 13.2 TBu for RAID 5 (7+1) or 11.3 TBu for RAID 5 (3+1). For the PowerMax 8000 storage array, Flash Capacity Packs are available in increments of 13.2 TBu.

- PowerMax storage arrays scale out by aggregating up to two bricks for the PowerMax 2000 storage array, and up to eight bricks for the PowerMax 8000 storage array in a single system with fully shared connectivity, processing power, and linear scalability.

The PowerMax 8000 storage array is the recommended model for VDI deployments where:

- Mission criticality is paramount
- Both block and file storage are used
- Larger storage capacity is required

For more information, see [PowerMax Family](#) and the [Virtualized Desktop Infrastructure with Dell EMC PowerMax and VMware Horizon Enterprise 7 White Paper](#).

PowerScale storage

PowerScale offers various model offerings for unstructured data. Its features include:

- File and object storage technologies with NVMe support
- Cloud integration
- Inline data deduplication and compression
- Multiprotocol support—IPv4, IPv6, NFS, SMB, HTTP(s), S/FTP, and HDFS
- Scale up and scale out. The PowerScale family consists of various solution platforms, all using the OneFs operating system
- A range of models tailored for scale up (high performance) and scale out (high storage capacity) needs

PowerScale is the recommended model for running professional graphics applications such as Esri ArcGIS Pro, Revit, Inventor, 3DS Max, and AutoCAD. These applications typically deal with large datasets. In the case of GIS applications, these datasets can consist of large cartographic files containing image data and meta data.

The Isilon F800 is recommended for VDI deployments where the following are required:

- Performance—Up to 250,000 IOPS
- Larger storage capacity—From 96 TB to 924 TB in a single 4U chassis and up to 58 PB raw storage in a single cluster

For more information, see [PowerScale Family](#) and the [PowerScale Specification Sheet](#).

CPU and GPU utilization

The testing methodology used in the [Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#) used two of the available GPU schedulers:

- Fixed
- Best Effort

The Fixed scheduler GPU policy was primarily chosen to provide a consistent GPU resource utilization to reduce variability while performing benchmarking analysis.

The Best Effort scheduler GPU policy better represents real world user configurations and the typical user experience, but it does not necessarily provide the utilization consistency required for setting benchmarks. Proving results of both GPU scheduling policies provides a more holistic analysis.

When reviewing both the CPU and GPU utilization data in the sizing guide, consider the relevant GPU scheduling policy. The GPU scheduler can cause CPU utilization to vary because the GPU accelerator handles graphics offloading.

i **NOTE:** Data presented in the [Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#) uses virtual workstation hosts based on Intel Xeon Gold 6154 CPUs (18 cores @ 3.0 GHz base, Max Turbo @ 3.70 GHz).

Both the VxRail and PowerEdge virtual workstation hosts in this document are based on Intel Xeon Gold 6254 CPUs (18 cores @ 3.1 GHz base, Max Turbo @ 4.00 GHz).

It is recommended that you test and validate the appropriate configuration options to meet the needs of your users.

Conclusion

Virtual workstation solutions from Dell EMC Ready Solutions for VDI accelerated by NVIDIA T4 and RTX 6000 GPUs together with NVIDIA vWS software offer an excellent platform to run the professional graphics applications that are used in the GIS sector with Esri ArcGIS Pro. These virtual workstations provide an experience that equals physical workstations. The solution simplifies the provisioning and management of virtual workstations so that your IT teams can focus on innovation. Creative and technical professionals get a high-quality interactive graphics platform that fosters collaboration and provides flexibility. The virtual workstations are secure and the organization's intellectual property is not compromised.

We provide virtual workstation configurations that are based on Esri's and NVIDIA's ArcGIS Pro sizing guide, thus enabling a predictable performance level from our solutions. The solution configurations in this reference architecture show the best way to integrate several Dell Technologies hardware platforms with NVIDIA T4 and RTX 6000 GPUs and virtual workstations powered by NVIDIA vWS.

The Dell EMC Ready Solutions for VDI team recommends the solution configuration in this reference architecture for running the professional graphics applications that are typically used in the GIS sector. However, we recommend that you perform pilot tests to right-size the virtual workstation environment according to your application requirements and user needs.

References

Dell Technologies documentation

The following links provide additional information from Dell Technologies. Access to these documents depends on your login credentials. If you do not have access to a document, contact your Dell Technologies representative.

- [VDI Design Guide—VMware Horizon on VxRail and vSAN Ready Nodes](#)
- [PowerEdge R740xd](#)
- [Dell EMC Ready Solutions for VDI Info Hub](#)
- [TechBook—Dell EMC VxRail System](#)
- [Planning Guide—Dell EMC VxRail Network Planning](#)
- [Planning Guide—VMware Cloud Foundation 3.x on VxRail](#)
- [Dell EMC PowerSwitch S-Series 25GbE switches](#)
- [Dell EMC PowerSwitch S-Series 10GbE switches](#)
- [Dell Latitude Laptops and Two-in-Ones](#)
- [Dell OptiPlex Business Desktops and All-in-Ones](#)
- [Dell Precision Workstations](#)
- [Wyse Thin Clients](#)
- [Dell EMC PowerProtect DD Series Appliances](#)
- [Dell EMC PowerStore Scalable All-Flash Storage](#)
- [Dell EMC PowerMax NVMe Storage](#)
- [Dell EMC PowerScale Family](#)

NVIDIA documentation

The following link provides additional information from NVIDIA:

- [NVIDIA Quadro Virtual Data Center Workstation Application Sizing Guide for Esri ArcGIS Pro](#)
- [NVIDIA Virtual GPU Software Quick Start Guide](#)
- [NVIDIA Virtual vGPU Scheduler documentation](#)

Esri ArcGIS Pro documentation

The following links provide additional information from Esri:

- [Esri ArcGIS Pro Overview](#)
- [Esri ArcGIS Pro Getting Started Guide](#)
- [Esri ArcGIS Pro Display options guide](#)
- [Esri Delivering ArcGIS Pro Virtually in High Resolution](#)

VMware documentation

The following links provide additional information from VMware:

- [VMware Horizon 8 Configuration Limits](#)
- [VMware Horizon 7 Sizing and Limitations and Recommendations](#)
- [VMware Workspace ONE and VMware Horizon 7 Enterprise Edition On-premises Reference Architecture](#)
- [VMware Horizon 7 Enterprise Edition Multi-Site Reference Architecture](#)
- [VMware Horizon Resources Page](#)

- [VMware Blast Policy Settings](#)
- [VMware PCOIP Policy Settings](#)
- [VMware Horizon License FAQ](#)
- [VMware EVC and CPU Compatibility FAQ](#)
- [VMware Update to VMware's per-CPU Pricing Model](#)
- [VMware Data Protection for a VMware Horizon VDI Environment using Dell EMC Data Protection Suite Operations Guide](#)