

Virtualization of ArcGIS Pro

An Esri® White Paper
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Virtualization of ArcGIS Pro

Introduction Knowledge workers are no longer beholden to a single device to get their work done. As the IT industry virtualizes more desktops and applications, geographic information system (GIS) professionals will expect professional desktop GIS software to work well in those environments. Large-scale projects deploying ArcGIS® Pro in virtualized environments are under way. For this reason, and to provide Esri customers with best practice recommendations, Esri's performance engineering team has tested ArcGIS Pro in [VMWare Horizon View](#), [Microsoft Hyper-V](#), and [Citrix XenDesktop+XenApp](#).

Using the test results of both automated load tests and hands-on testing events with real users, Esri has a very good understanding of what it takes to successfully deploy ArcGIS Pro in virtualized environments. We also understand how many virtual machines (VMs) that a virtualization server can host to deliver an acceptable user experience.

The result of this extensive effort is that Esri can verify that ArcGIS Pro virtualizes well, and the virtualized environment can deliver a user experience for GIS professionals that is equally as good as using a stand-alone, high-end desktop machine.

ArcGIS Pro— Performance in Virtual Environments

ArcGIS Pro can be virtualized and performs with both high performance and scalability in major virtual desktop infrastructure (VDI) environments. It is very important to understand that ArcGIS Pro does *not* scale the same way in virtualized environments as ArcMap™. In order to provide your users with a high-quality user experience, ArcGIS Pro requires different system resources. Esri has worked closely with Citrix, Microsoft, NVIDIA, VMware, Dell, Cisco, and others, to understand the performance and scalability of ArcGIS Pro in these virtualized environments.

ArcGIS Pro User Experience

ArcGIS Pro delivers a great desktop user experience when working with 2D and 3D data. This was a development requirement of the application and was delivered by design. There are a number of important characteristics that help deliver this:

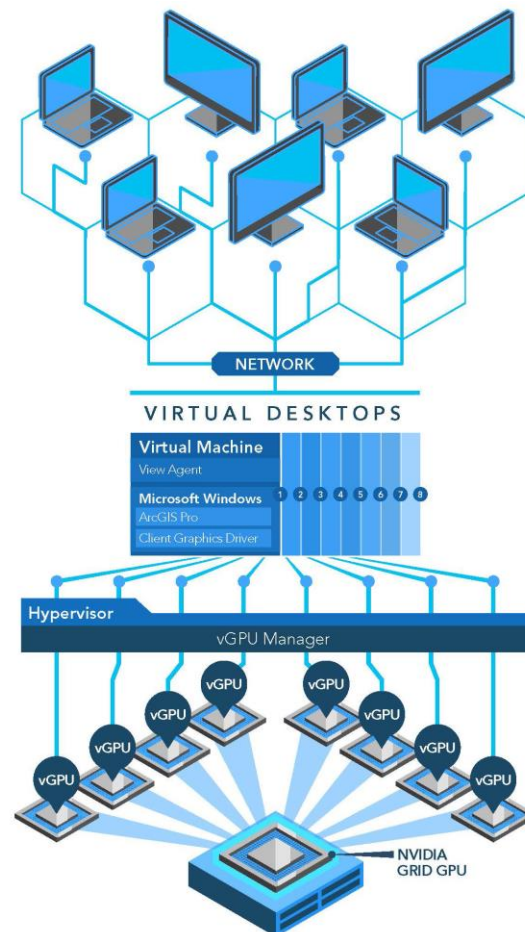
- ArcGIS Pro is a multithreaded application. Multiple threads take advantage of modern multicore processors to perform multiple tasks concurrently, such as geoprocessing in the background while rendering in the foreground.
- ArcGIS Pro is built with a state-of-the-art rendering engine. This new rendering engine takes advantage of DirectX and OpenGL graphics libraries and graphics acceleration offered by modern GPUs.

These characteristics help deliver an excellent user experience with a smooth map display and fluid, game-like graphics. Importantly, these two characteristics also cause ArcGIS Pro to virtualize differently than ArcMap to reach the high level of responsiveness and display fluidity that a user experiences on a stand-alone desktop machine.

Virtualization Requirements of ArcGIS Pro

Since the requirements are different from ArcMap, to properly virtualize ArcGIS Pro, it is important to properly configure the virtualization environment to support multiple VMs running a high-end graphics application. This includes ensuring adequate processors and shareable graphics processing units (GPU) on the host.

- **Processors**—The physical processors must have enough cores to support VMs with modern multithreaded applications. This is not only for ArcGIS Pro but also other multithreaded applications. Examples of appropriate processors are those on servers used in the Esri Performance Engineering lab, which have two Intel E5-2680 V2 processors. Each processor has 12 cores.
- **GPUs**—The GPUs and drivers must be designed for virtualized environments. Each server in the Esri Performance Engineering lab has two NVIDIA GRID K2 GPUs. These are important, since the DirectX and OpenGL libraries utilize the GPU to deliver the map rendering at acceptable frames per second. Without a GPU, the rendering engine will use the Windows WARP software rasterizer. WARP can be useful in a pinch but will not deliver the same user experience as a GPU.



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NVIDIA GRID vGPU Profiles

NVIDIA GRID K2 cards were used in Esri's test environment; therefore, the NVIDIA GRID vGPU profiles used to configure the frame buffer and VM/GPU density are very important. This is discussed in more detail in the Esri blog [Virtualizing ArcGIS Pro: NVIDIA Grid vGPU Profiles](#).

For Esri's 2D tests, we found that the K220Q or K240Q NVIDIA GRID vGPU profiles are adequate. For the 3D tests, Esri found that the K240Q or K260Q profiles are needed. The server configuration described above can support the following density:

- 10–12 VMs with ArcGIS Pro using 3D data and the K240Q profile
- 16–20 VMs with ArcGIS Pro using 2D data and the K220Q profile

Card	Physical GPUs	Virtual GPU Profile	Intended User(s)	Frame Buffer (MB)	Max Resolution	Maximum vGPUs	
						Per GPU	Per Board
GRID K2	2	K280Q	Designer	4096	2560x1600	1	2
		K260Q	Designer	2048	2560x1600	2	4
		K240Q	Power User	1024	2560x1600	4	8
		K220Q	Power User	512	2560x1600	8	16

Common Question 1: *Will the hypervisor need access to a graphics processing unit?*

A GPU is very effective at improving the user experience in graphic-intensive applications because rendering on virtual machines can be passed directly to a GPU. In some simple 2D workflows, a GPU may not be required, but many 2D and all 3D workflows, when virtualizing ArcGIS Pro, require having a shareable GPU to maintain a high-quality rendering experience. This provides your users with the same experience they can get from a physical machine.

ArcGIS for Desktop Virtualization Appliance

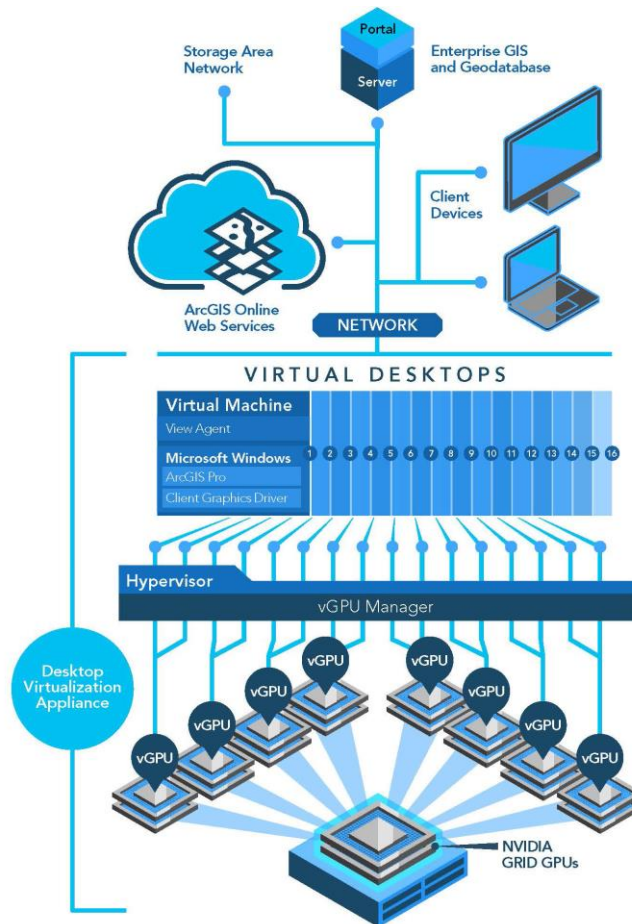
Common Question 2: *Is there an easy way to successfully deploy a virtualized environment for ArcGIS Pro?*

Esri collaborated with NVIDIA, Dell, and VMware to provide a well-tested hardware solution that can virtualize ArcGIS for Desktop, including ArcGIS Pro, in a single "box."

To help provide a clear description of the hardware needed to virtualize ArcGIS Pro, we have collaboratively designed the **ArcGIS for Desktop Virtualization Appliance**.

The ArcGIS for Desktop Virtualization Appliance was showcased at the Esri User Conference to thousands of GIS professionals. It was configured with VMware vSphere 6.0, Horizon View, and 2 NVIDIA GRID K2 GPUs. This appliance is based on a Dell Precision Rack 7910 and takes advantage of vGPU technology, the hardware sharing of the GPU, to achieve greater density while delivering a workstation-class user experience. This appliance is an excellent solution for delivering ArcGIS Pro in a virtualized environment.

Esri's tests confirm performance, user experience, and the VM/GPU density of ArcGIS Pro on this platform. The tests included a GPU-intensive 3D test, which showed the appliance can support 12–16 concurrent ArcGIS Pro Virtual Machines.



Dell 7910 Precision Rack Server

- Dual Intel Xeon Processor E5-2680 v3, 2.5GHz, 12 cores
- 3.75 TB SSD storage
- 275 GB RAM
- Two NVIDIA GRID K2 GPUs



Deployment

The ArcGIS for Desktop Virtualization Appliance is able to support up to 16 Virtual Machines running ArcGIS Pro while delivering an excellent user experience using the [K240Q GRID profile](#). Each VM will be configured with the following:

- Six virtual CPUs
- 8 GB RAM
- 1 GB Frame Buffer

A Do-It-Yourself Sample Configuration

The ArcGIS for Desktop Virtualization Appliance is an all-in-one package for successful desktop GIS virtualization. It is available now and can be ordered directly through Esri at esri.com/hardware.

Virtualization of GIS applications (e.g., ArcMap, ArcCatalog™) and desktops (virtual desktop infrastructure) in the Esri user community is not a new concept. Many organizations have existing IT infrastructure and IT staff with experience in virtualization of ArcGIS for Desktop. Since ArcGIS Pro scales differently in virtualized environments from ArcMap, it may be helpful to look to other organizations to see what they purchased to scale their virtualized use of ArcGIS Pro.

An early adopter of ArcGIS Pro that has deployed it in a virtualized environment is a large water management district in Florida. This organization has a strong IT staff with experience in virtualization with VMware. Esri, NVIDIA, and VMware have all offered to support it to achieve success. Esri strongly encourages any of its customers to contact these vendors as well for support, as they are very serious about Esri users being successful in deploying virtualization environments.

Common Question 3: *I already have a virtualization environment. What additional hardware do I need to buy?*

The large water management district purchased a Cisco C-Series box (C240-M4) and these key components to successfully deploy its virtualized environment:

- Server: Cisco C-Series C240 M4
- Processors: (2x) 2.50 GHz E5-2680 v3/120W 12C/30 MB Cache/DDR4 2133 MHz
- Memory: 256 GB (16x) 16 GB DDR4-2133-MHz RDIMM/PC4-17000/dual rank/x4/1.2v
- Storage: 1.2 TB (4x) 400 GB 2.5-inch Enterprise Performance SAS SSD
- GPUs: (2x) NVIDIA GRID K2 card

Conclusion

Desktop virtualization is increasing and will continue to do so as more physical desktops are moved to VDI solutions and delivered via servers in a data center, either on-premises or in the cloud, from vendors with desktop-as-a-service (DaaS) offerings.

Esri is committed to testing and benchmarking ArcGIS Pro performance, scalability, density, and the user experience in virtualization platforms. Esri has great collaborative relationships with the virtualization vendors that are most heavily used and that are delivering the best user experiences for you.

An important note for Esri customers already using ArcMap in VDI or application virtualization environments is that ArcMap and ArcGIS Pro virtualize differently, and a new configuration may be needed. ArcGIS Pro is state-of-the-art, professional-grade GIS software with a new DirectX/OpenGL-based rendering engine. This rendering engine allows ArcGIS Pro to deliver the 2D and 3D data visualization and spatial analysis that is

expected from a top-tier GIS application. The user experience delivered by this rendering engine is incredible for both 2D and 3D data.

For a production virtualization environment serving many users, a normal graphics card simply will not do. The ArcGIS Pro rendering engine benefits from a shareable GPU that resides on the machine with the hypervisor. Esri used NVIDIA GRID K1 and K2 cards in its test environment, as they are designed exclusively for virtualization environments. The K1 and K2 cards have multiple GPUs that can be shared by multiple VMs. Given the results of its testing, Esri recommends the K2 card to provide the best user experience and the best VM/server density. The sharing of the GPUs is controlled/managed by NVIDIA GRID vGPU profiles. These profiles control how many VMs share a GPU, the graphics memory available to a VM, and therefore the VM/GPU density.

By using the Esri-tested specifications noted in this paper, Esri is confident that ArcGIS Pro can be delivered—with a user experience that equals a stand-alone desktop machine—to your professional GIS staff in a virtualized environment.



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