ArcGIS® Server and Virtualization

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An ESRI White Paper

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Executive Summary

Virtualization is becoming a standard IT practice. It is becoming increasingly popular among ArcGIS® customers as well. Virtualization solutions are being broadly used in test, development, and production environments, providing tremendous benefits to ArcGIS Server deployments. ESRI uses virtualization technologies for the development, quality assurance, and certification processes of ArcGIS Server. This document provides an overview of virtualization and addresses some of the most common questions regarding ArcGIS Server and virtualization.

What Is Virtualization

Virtualization is a broad term that refers to the abstraction of computer resources (network, disk, memory, etc.). In the context of ArcGIS Server, virtualization is generally used for platform virtualization, which allows multiple operating systems and applications to run in a physical machine. This is done through the concept of virtual machines.

What Is a Virtual Machine

A virtual machine is an isolated software container that can run its own operating system and applications as if it were a physical computer. A virtual machine's characteristics are exactly like those of a physical computer, as it contains its own virtual CPU(s), RAM, hard disk, network interface cards, and so forth. The virtual machine typically shares the underlying hardware resources with other virtual machines but is completely isolated from others at the operating system level.

Benefits of Virtualization

Virtualization technologies allow organizations to

- Reduce provisioning times for new servers. Provisioning means defining server configuration based on organizational requirements.[1]

- Reduce the need for new servers and the number of existing servers as well as improve the use of existing servers (i.e., implementing a server consolidation strategy).

- Reduce the cost of ownership (power, cooling, space, maintenance costs).

- Prevent applications from impacting each other when upgrades or changes are made, for example, running different versions of ArcGIS on the same physical server.

- Increase business continuity by reducing downtime and recovering quickly from unplanned outages with the ability to back up and migrate entire virtual environments with no service interruption.

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[1] Wikipedia, s.v. "Provisioning," http://en.wikipedia.org/wiki/Provisioning (accessed April 2009).

Available Virtualization Technologies

Some of the leading virtualization products on the market today include

■ VMware®

VMware is currently the most popular virtualization platform with ESRI customers. For those customers, VMware is primarily used to virtualize ArcGIS Server environments. However, customers are increasingly using it to virtualize ArcGIS Desktop as well. For more information, visit www.vmware.com.

■ Microsoft® Hyper-V™

Hyper-V is the virtualization solution included with Microsoft Windows Server® 2008. It is very quickly growing in acceptance among ArcGIS users. For more information, visit www.microsoft.com/windowsserver2008.

■ Sun™ Microsystems Solaris™ Containers

Solaris Containers is the native virtualization solution for Solaris 10. ArcGIS customers primarily use it to virtualize the database server. For more information, visit www.sun.com/solaris/containers.

■ Citrix® XenServer™ and Citrix Essentials™

Citrix offers XenServer for free and includes it with the more advanced virtualization management solution Citrix Essentials, which provides additional functionality including automation and integration with Microsoft Hyper-V. For more information, visit www.citrix.com/xenserver.

How ArcGIS Server Supports Virtualized Environments

ESRI fully supports ArcGIS Server in virtual environments as long as its components run on a supported platform. Customers can contact the ESRI Support Center (support.esri.com) to get assistance with supported platforms.

How ArcGIS Server Performance Is Affected when Running on a Virtual Machine

Running software in a virtualized environment affects the performance of any application to some degree. Like any application, ArcGIS Server performance is negatively impacted by virtualization. As the workload on server processing becomes heavier, the decline in performance becomes more obvious.

Tests performed by ESRI indicate that intensive disk I/O operations, such as dynamic mapping and map caching, perform faster on physical machines than on virtual machines. Some CPU-intensive applications are also negatively affected in a virtual environment. Testing has shown that the performance can differ by virtualization vendor (sometimes dramatically) and by the operation being executed. For example, calls to ExportMapImage on a moderately complex map service (40 vector layers and 3 raster layers) through our REST API translate roughly into a 10 percent performance hit. It is important to highlight the fact that a suboptimal configuration of the virtual environment can lead to larger performance hits of up to 60 percent.

Therefore, observing best practices on the configuration of the particular virtualization environment as well as performance testing are recommended when assessing virtualization in order to properly design and size the system.

In many cases, performance is only a minor consideration because the benefits of virtualization outweigh the performance implications. The impact of virtualization on performance is usually taken into account for the purpose of properly sizing the system to support anticipated use.

Major Decision Factors for Considering Virtualization

Organizations investigating virtualization consider price and technical support along with a wide range of issues and questions that influence their decision of whether to implement a solution—below are just a few:

■ Does the technology provide physical-to-virtual conversion tools and utilities?

■ Are there administrative tools, such as a management console?

■ Can the technology move a virtual machine from one physical host to another without taking it down?

■ Does the technology eliminate the physical host as a single point of failure (e.g., does it support high availability)?

■ Can the technology support hosting different operating systems within the virtualized environment (e.g., multiplatform [OS] virtual machine)?

■ Does the technology support paravirtualization (an enhancement on virtualization in which a guest OS is recompiled prior to deployment in the virtual environment)? This allows for optimized execution.

■ Does the technology support network interface cards (NICs), unicast isolation, Internet Small Computer System Interface (iSCASI), Simple Network Management Protocol, and other external storage and networking compatibilities?

■ Does the technology allow multiple CPUs to work on a single process (e.g., symmetric multiprocessing)?

Deploying ArcGIS Server in a Virtualized Environment

In a recent survey of over 1,000 ArcGIS Server 9.3 customers, many participants claimed that the decision to virtualize (or not) was managed by the IT department as a broader strategy within the organization to reduce costs, conserve resources, and improve efficiencies.

Additionally, over 30 percent of the participants were already running or planning to run ArcGIS Server in a virtual environment within the next 12 months, 20 percent indicated a high interest in virtualization, and only 4 percent were certain that they would not virtualize their ArcGIS Server deployment.

Advantages of Deploying ArcGIS Server in a Virtualized Environment

Organizations using ArcGIS Server in a virtualized environment realize a variety of advantages, including

■ The ability to run different versions of ArcGIS Server on a single physical machine. This is especially helpful in development environments as well as implementation of version migration strategies.

- A reduction in security risks to the overall computing infrastructure is achieved by isolating externally facing ArcGIS Server applications in specific virtual machines.

- Compliance with the organization's disaster recovery plan require ArcGIS Server applications and services to be quickly configured in the event of a catastrophe.

- Accelerated development and deployment of self-contained ArcGIS Server applications is realized.

- Maximized use of hardware and computing infrastructure simplifies server provisioning and system scaling. For example, new machines could be rapidly configured as server object containers (SOCs) to accommodate peak usage.

Conclusion

With virtualization becoming a standard IT practice and ArcGIS Server supporting all components of a virtualized environment on supported platforms, more organizations are considering it for their own ArcGIS Server deployments. Choosing the right virtualized environment depends heavily on the organization's broader IT strategy, the perceived benefits virtualization provides, and the particular features and functions included in the available virtualization solutions. According to ArcGIS users of virtualization technologies running multiple versions of ArcGIS Server, security, business continuity, rapid application development, and simplified server provisioning are more important advantages of virtualization than performance. ESRI uses virtualization technologies for the development, quality assurance, and certification processes of ArcGIS Server.

For more information about how ArcGIS Server is licensed in a virtualized environment, contact your local ESRI account representative. If you are located outside the United States, contact your local ESRI distributor.

About ESRI

For four decades, ESRI has been helping people make better decisions through management and analysis of geographic information. Our culturally diverse staff work with our business partners and hundreds of thousands of people who use GIS to make a difference in our world.

A full-service GIS company, ESRI offers support for implementing GIS technology from the desktop to enterprise-wide servers, online services, and mobile devices. GIS solutions are flexible and customizable to meet the needs of all our users.

Our Focus

At ESRI, we focus on promoting the value of GIS and its applications throughout the world and pay close attention to our users' needs. Our software development and services respond to our customers with products that are easy to use, flexible, and integrated. Our technology is multidisciplinary, productive, and valuable to our users.

We have a strong commitment to educating our customers through ESRI's various training programs. ESRI is a socially conscious business and invests heavily in issues regarding education, conservation, sustainable development, and humanitarian affairs.

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