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# Windows Server 2008 Hyper-V

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## Introduction

One of the biggest features of Windows Server 2008 isn't even really in Server 2008 yet: Hyper-V, the new virtualization platform (formerly code-named Viridian). But the technology has reached the release candidate stage at this writing (download it for free from Microsoft's website; hunt for KB949219), and it's such an important feature that we thought it would be worthwhile exploring the background of the technology – so that when it does make it into your hands, you'll know how it is different from the virtualization solutions you may have already seen or used.

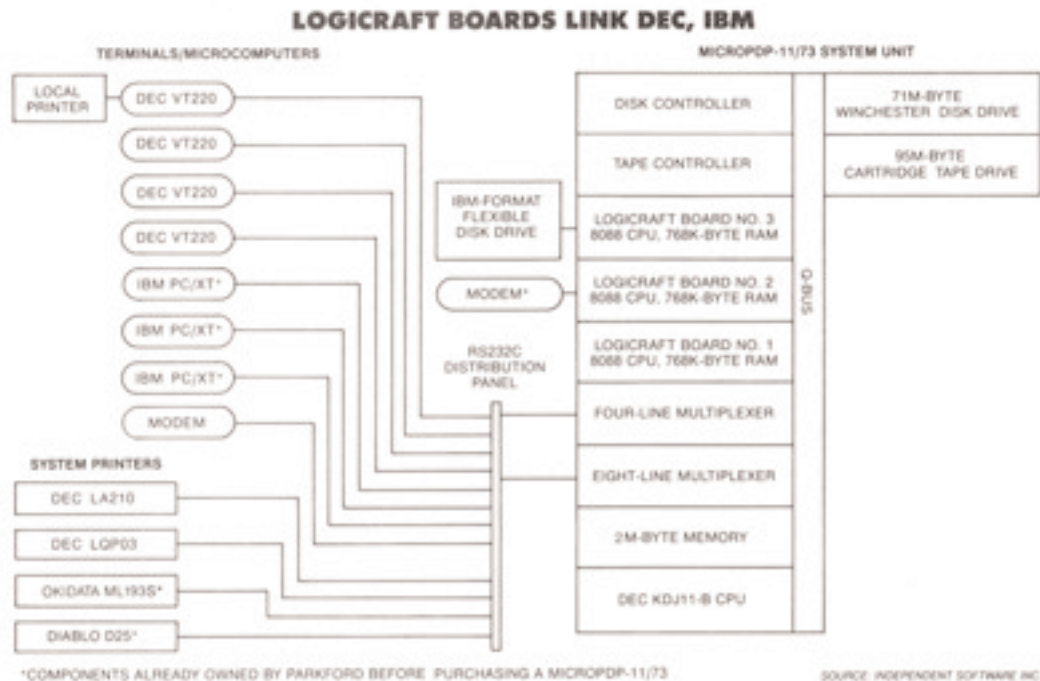
The topics in this white paper are:

- Early Hardware-Based Virtualization
- Software-Based Virtualization
- Virtualization Pros and Cons
- Enter Hyper-V
- Hyper-V Requirements
- Hyper-V Features
- Conclusion
- More Information

## Early Hardware-Based Virtualization

The concept of a "virtual" machine (really, a virtual computer) goes back to mainframe days. For example, in the 1980s, Digital Equipment Corporation VAX systems were capable of running plug-in boards that simulated a standalone IBM PC (see Figure 1 for a system I deployed, and wrote about, some twenty years ago). The trend continued throughout the decade as companies (for example) built "emulator" boards permitting Apple computers to run PC programs.

Hardware-based virtual machines provided excellent performance because they typically included dedicated processors and memory, using the host system only for I/O. The drawbacks were that they did not always provide full compatibility, and they were expensive.



**Figure 1. A hardware-based VM setup (courtesy Independent Software Inc.)**

## Software-Based Virtualization

In recent years, high-speed processors and low-cost memory have made it possible to create virtual machines without requiring the installation of new hardware (with the possible exception of extra RAM). These software-only VMs leverage the host system's processor, memory, and I/O devices. (See Figure 2.)

Typical software virtual machine features include:

- Ability to run a different OS than the host machine, as long as CPU compatibility exists
- Simulation of private memory by "carving out" a portion of shared host memory
- Simulation (possibly inaccurate!) of I/O devices
- User-configurable settings (e.g., RAM)
- Poorer performance as the number of VMs per physical machine increases

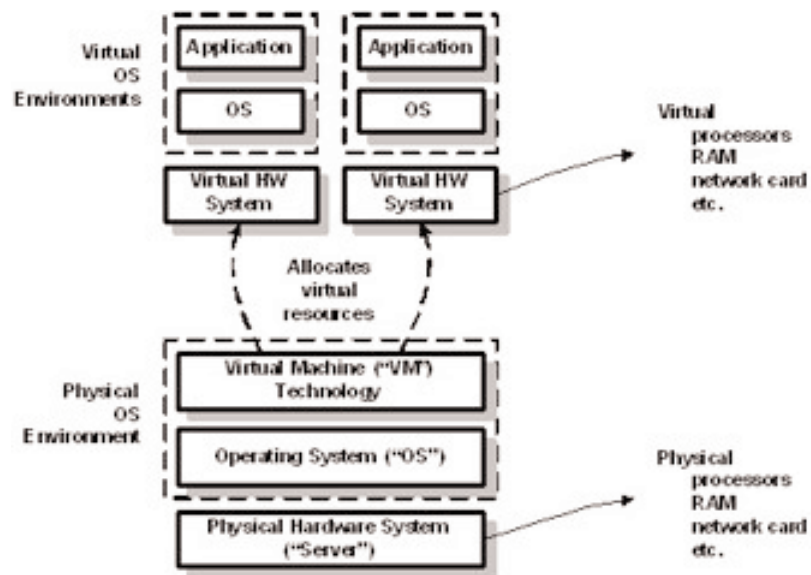
Microsoft's more powerful virtual machine solution is its Virtual Server product, which runs on top of Internet Information Service (IIS). Microsoft's stated requirements and specifications for VS2005 are as follows:

Intel or AMD 550MHz or greater processor

Standard Edition, maximum 4 CPU's

- Enterprise Edition, limited only by host OS
- Each VM runs only as a 1-CPU system
- CD or DVD drive
- SVGA or higher display
- RAM required on host OS:
  - 256MB (XP, S2003 Standard, S2003 Enterprise)
  - 512MB (S2003 Datacenter)

- 2GB disk space on host OS
- Host OS must use NTFS
- Supported host OSs include:
- Windows Server 2003, 32-bit, all versions
- Small Business Server 2003
- Windows XP Professional
- Supported guest OSs include:
- Windows Server 2003, 32-bit, all versions except Datacenter
- Windows Server 2000, all versions except Datacenter
- NT Server 4.0 SP6a



**Figure 2. Software-based VMs trade speed for low cost.**

From Microsoft's product naming, you would assume that Virtual Server 2005 is for hosting server VMs, and Virtual PC 2007 is for hosting client VMs. Confusingly, that assumption would be incorrect! Both products can host server and client VMs.

Virtual PC 2007, the less-expensive software virtualization choice (until Microsoft made both this product and Virtual Server 2005 available for free), can host client and server operating systems in VM sessions, just like Virtual Server. However, the Virtual PC product differs in the following ways:

- It doesn't require IIS.
- It doesn't offer an administration website, but rather, a "Virtual PC Manager" utility, which is much simpler to use and configure.
- It permits drag-and-drop of files and folders between host and guest – something that not even the higher-end Virtual Server 2005 product can do!
- It supports better virtualization of sound and display devices than Virtual Server.
- Generally speaking, files are compatible between the two products, and you can move VHDs between them.

Of course, Microsoft is by no means the only game in town when it comes to virtualization. VMware has established a strong reputation for high quality products that are highly configurable. The company has also gone further than Microsoft in terms of on-line, real-time VM backup with its "vMotion" technology.

VMware Workstation 5.5 is more-or-less comparable to Microsoft Virtual PC 2007. It supports Windows, Linux, Solaris, and Netware.

VMware GSX Server (now called simply "VMware Server") is perhaps most comparable to Microsoft Virtual Server 2005, but unlike Virtual Server 2005, it supports 64-bit guest operating systems and Symmetric MultiProcessing for the guest OS. It is available for free. If your needs grow, you can migrate up to ESX Server (now included as part of a suite of products known as "VMware Infrastructure").

VMware ESX Server is generally viewed to be in a class by itself. It supports server clustering and does not have the performance caveats that Microsoft publishes regarding Virtual Server 2005.

VMware Player is free software that allows you to "run" pre-built VMware virtual machines.

## Virtualization Pros and Cons

One of the big reasons that virtual machines have caught fire in recent years is the cost savings that they provide. It is generally less expensive to run multiple virtual machines on one physical box than it is to run multiple physical boxes. This is true both from the initial cost standpoint and from the ongoing cost standpoint (think of energy consumption, for example).

Simplification of individual servers is also a potential benefit. Where in the past you may have had a single machine doing DHCP, DNS, and file server duties, for example, you can separate those functions into separate VMs, making it possible to optimize and secure each VM for the single job that it now performs.

This isolation of functionality also means that there may be less impact on your organization when a single virtual server goes down for scheduled maintenance. In our previous example, a necessary reboot to a DHCP server will have no impact on the other servers handling DNS and file services.

Of course, that benefit can cut both ways. The failure of a physical server could be more damaging if that physical server is hosting multiple virtual servers.

Another benefit to virtualization is that you can perform testing (for example, Group Policy) in a "sandbox" without risking damage to production environments. If you've ever been denied funding for a test lab, you can now resubmit that request with a lower figure for hardware dollars, because you can simulate a network environment on a single physical box.

Perhaps the biggest downside to virtualization has been the speed compromise. As all longtime IT folks know, doing things in hardware is always faster than doing them in software – but virtualization, until recently, has been accomplished almost entirely on the software side. That is one reason for its glacial performance compared to physical machines.

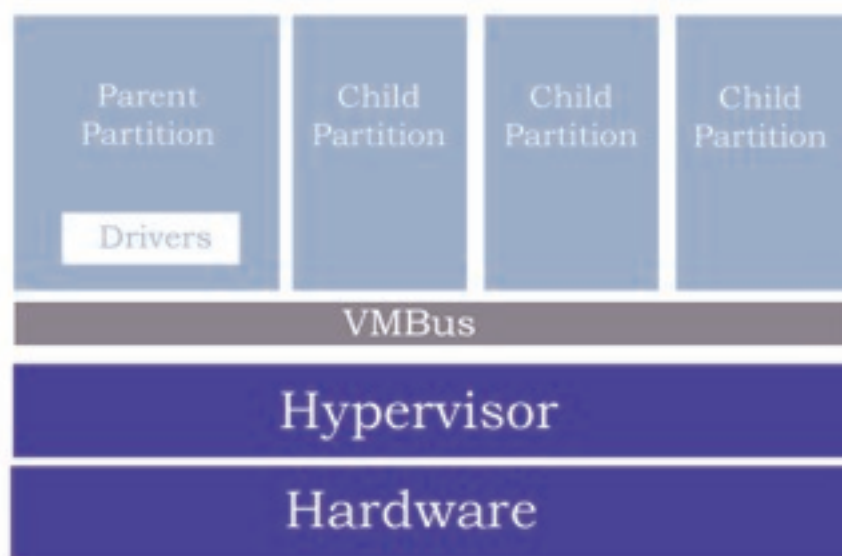
A close second on the negative side of the ledger has been device driver compatibility. For example, with the Microsoft solutions before Hyper-V, the virtualized display driver is an S3 Trio, which is too underpowered even

to run Vista AERO. And as if underpowered emulation wasn't bad enough, some device classes didn't virtualize at all, such as USB devices.

## Enter Hyper-V

The latest generation of virtualization technology from Microsoft is actually a hybrid of the hardware and software approaches. Yes, there's still software, but it has a smaller footprint. For example, at the lowest level, we see a minimalist layer called the hypervisor. The hypervisor sits on top of the hardware in a very thin layer and talks to the virtualization-specific processes running on compatible processors, such as Intel-VT and AMD-V. It is this "hardware assist" that dramatically improves the performance of virtual machines running in the Hyper-V environment.

(You install the hypervisor as the Hyper-V "role" in Server 2008's Server Manager console. By the way, you can install this role on a normal Server 2008 machine, or on a Server Core system – as long as the system is 64-bit. After installation, you will manage Hyper-V through the new Hyper-V console in the Administrative Tools folder.)



**Figure 3. Hyper-V combines elements of software and hardware virtualization.**

Just above the hypervisor is the VMBus, or Virtual Machine Bus. Here's where communications occurs between the different "partitions." Think of a partition as a virtual machine, because most of them are. One partition is special, and that's the parent partition. This is the partition where you manage the various other "child" partitions that may be running on the same physical box; the parent partition must be running Server 2008 (either regular or core). The VMBus is how the parent partition communicates with the child partitions.

So-called "enlightened" clients (ones that know about, and take advantage of, Hyper-V) running in child partitions will effectively use the device drivers provided by the parent partition operating system. The parent partition is in charge of all the hardware for the physical box, and makes that hardware available to enlightened clients with low overhead.

The terminology associated with this scheme is “Virtual Service Provider” (VSP, running on the parent partition) and “Virtual Service Client” (VSC, running on the child partition). Server 2008 comes with services for mass storage, video, and network driver access via the VSP/VSC model.

## Hyper-V Requirements

Hyper-V will eventually be available as part of your Server 2008 purchase. You will be able to buy versions of Server 2008 with or without Hyper-V by selecting different SKUs, although the cost savings for the versions without Hyper-V will be minimal, if not negligible.

Some things to consider before jumping into the Hyper-V pool:

- You must be using hardware that supports the new virtualization features. Intel and AMD both offer such hardware. This is not technology that you can retrofit onto older motherboards that do not have explicit virtualization support. Note also that Hyper-V does not support Itanium (IA-64) processors.
- You must have a 64-bit environment. Hyper-V only runs on x64-bit editions of Windows Server 2008. Microsoft has said that they have no plans to release a 32-bit version of Hyper-V.
- You must be running approved and tested hardware. The hypervisor layer interfaces directly between the hardware and the parent and child partitions. Solid device drivers are required to avoid the “flakiness” that many of us have seen with software-based VM solutions.
- Physical memory needs to be adequate for the environment(s) to be virtualized. This means at least 512MB for the parent partition, plus an amount for each child partition that depends on the operating system and services running, as well as 32MB overhead for each child partition.
- Tested guest operating systems as of this writing include Server 2008, Server 2003, Windows XP, Windows Vista, and SUSE Linux.

## Hyper-V Features

So what are some of the benefits one may expect from a Hyper-V setup? They include the following:

- Support for both 64-bit and 32-bit guest operating systems
- Support for non-Windows guest operating systems (e.g. certain versions of Linux)
- Up to 64GB guest operating system memory
- Up to 4 processor cores emulated for guest operating systems
- Up to 2TB host memory
- Up to 16 processor cores on the host
- Support for clustering (with appropriate versions of 2008 Server) across multiple guest VMs
- Support for Network Load Balancing across clusters
- Ability to migrate one VM to another with relatively short downtime (but not zero downtime, as VMware offers with vMotion)
- Manage Hyper-V with Server Manager console
- Manage VMs with System Center Virtual Machine Manager
- Create VM snapshots to which you can revert if necessary

## Conclusion

The allure of virtual machines has existed for years, if not decades. Until now, however, you have always had to choose between the cost of hardware-based virtualization or the sluggish performance and poor device support of software-based virtualization.

address both of those concerns. Its insistence on a 64-bit environment is not a huge impediment because most of us realize that the 32-bit world's days have been numbered for quite some time, at least on the server side. Although my own experimenting with RC0 still reveals some usability and performance issues, the code isn't final yet as of this writing, and I have hopes that the final release of Hyper-V will be a major step forward towards realizing the benefits that I envisioned twenty years ago, when slapping 8088 circuit boards into the backplane of a PDP-11 and thinking that there had to be a better way!

## More Information

Learn more about Hyper-V at the following websites:

- <http://www.microsoft.com/virtualization/default.mspix>
- <http://blogs.technet.com/virtualization/default.aspx>
- <http://technet.microsoft.com/en-us/virtualization/default.aspx>
- <http://www.microsoft.com/events/series/windowsserver2008.aspx>

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## About the Author

Glenn Weadock is a longtime instructor for Global Knowledge and has co-developed with Mark Wilkins MOC courses on Server 2008 Active Directory and Server 2008 network infrastructure. He also consults through his Colorado-based company, Independent Software, Inc. and is the author of 18 computer books.