

Developer Zone

The Advantages of Using Virtualization Technology in the Enterprise

Submitted by Deleted User (https://software.intel.com/en-us/user/1113980) on March 5, 2012

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By Thomas Burger

Introduction

Virtualization technology is possibly the single most important issue in IT and has started a top to bottom overhaul of the computing industry. The growing awareness of the advantages provided by virtualization technology is brought about by economic factors of scarce resources, government regulation, and more competition.

Virtualization is being used by a growing number of organizations to reduce power consumption and air conditioning needs and trim the building space and land requirements that have always been associated with server farm growth. Virtualization also provides high availability for critical applications, and streamlines application deployment and migrations. Virtualization can simplify IT operations and allow IT organizations to respond faster to changing business demands.

The socio-political ramifications of global warming requiring good corporate citizens to meet greenhouse gas reduction targets, creates an added incentive for virtualization.

The availability of better virtual machine isolation through new Intel® Virtual Technology hardware support in commodity systems together with the broad availability of virtualization software provides a level of efficiency to meet these demands.

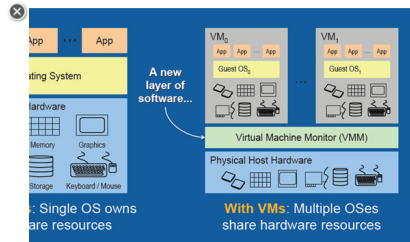
This paper discusses what virtualization is, how Intel technologies improve it, and how organizations can benefit from adopting virtualization into future IT plans.

What is Virtualization?

Virtualization is a combination of software and hardware engineering that creates Virtual Machines (VMs) - an abstraction of the computer hardware that allows a single machine to act as if it were many machines.

- Without VMs: A single OS owns all hardware resources
- With VMs: Multiple OSes, each running its own virtual machine, share hardware resources
- Virtualization enables multiple operating systems to run on the same physical platform

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Machine and VM Configurations

The Virtual Machine Monitor (VMM)

The VMM is the system at the core of virtualization. It acts as the control and translation system between the VMs and the hardware.

For the efficient controlling of physical platform resources; this includes memory translation and I/O mapping. Until recently the VMM used software methods of Binary Translation and Paravirtualization to achieve this. With the complex, time consuming operations involved to create and run them, virtual machines, until now, showed significant performance reductions compared to dedicated physical machines.

Intel Virtual Technology

Intel was first in providing hardware specifications to VMM vendors that significantly reduced the overhead of VMM operations and greatly improve the speed and abilities of the VMM. Intel® Virtual Technology (Intel® VT) is a specification that has been included in Intel hardware shipped since 2005. It provides a flexible set of hardware primitives to aid VMM software and has the broadest hardware and software support.

Intel VT not only speeds the operations of VMs, but it also reduces the complexity and provides a standard platform for the development of even more capable VMMs. Intel VT also contains a research component that works with VMM vendors to provide the future functionality they require. As an example, VMMs are taking advantage of Intel hardware and a virtual machine can now be created that uses four CPUs in a multiprocessor configuration.

Intel VT Goals:

Reduce VMM Complexity

- Close hardware "virtualization holes" by design
- Reduce need for device-specific knowledge in VMM

Enhance Reliability, Security and Protection

- Provide new control over device DMA and interrupts

Improve Functionality

- Provide support for legacy (unmodified) guest OSes
- Enable pass-through access to I/O devices (where appropriate)

Increase Performance

- Eliminate unnecessary transitions to VMM
- New address-translation mechanisms (for CPU and devices)[1]
- Reduce memory requirements (translated code, shadow tables)

Intel VT is comprised of the following hardware specifications:

- VT-x for the IA-32 and Intel®64 Architecture - Available in all Intel-based processors (server, desktop, mobile)
- VT-i for the Intel® Itanium® Architecture - Available in Intel® Itanium® processor-based servers since 2005
- VT-d for Directed I/O Architecture - Intel is working with VMM vendors to deliver software support with systems in 2007.
- Secure Virtualization Core™ Micro-architecture support for Intel® Trusted Execution Technology - A set of hardware extensions that provide creation of multiple separated execution environments (partitions) that help protect the confidentiality and integrity of data stored or created on the PC.

Table 1 - Intel® Virtualization Technology Benefits

Software-only Virtualization Solution	Virtualization with Intel® VT	End-user Benefits
Paravirtualization is required with certain Operating Systems	No paravirtualization required	Lower support and maintenance cost. No paravirtualization support required with update of guest OS
Large memory overhead required	CPU virtualization assistance reduces the need for memory overhead	Lower TCO and lower platform, energy, cooling, maintenance and inventory costs
De-privileging OS limits number of Operating Systems supported	OSs can often run on their intended layer avoiding the need to de-privilege	Increased functionality: mixed and varied OS
Only possible through complex VMMs that add latency and cost	Assists the VMMs with silicon based functionality	Resulting in lower cost, more powerful virtualization solutions

Advantages of Using Virtualization

Today's IT intensive enterprise must always be on the lookout for the latest technologies that allow businesses to run with fewer resources while providing the infrastructure to meet today and future customer needs. Virtualization utilizing Intel Virtualization Technology is the cutting edge of enterprise information technology. Intel is closely working with VMware, XENSource, Jaluna, Parallels, tenAsys, VirtualIron, RedHat, Novell and other VMM developers.

Server Consolidation

It is not unusual to achieve 10:1 virtual to physical machine consolidation. This means that ten server applications can be run on a single machine that had required as many physical computers to provide the unique operating system and technical specification environments in order to operate. Server utilization is optimized and legacy software can maintain old OS configurations while new applications are running in VMs with updated platforms.

Although a server supporting many VMs will probably have more memory, CPUs, and other hardware it will use little or no more power and occupy the same physical space reducing utilities costs and real estate expenditures.

Testing and development

Use of a VM enables rapid deployment by isolating the application in a known and controlled environment. Unknown factors such as mixed libraries caused by numerous installs can be eliminated. Severe crashes that required hours of reinstallation now take moments by simply copying a virtual image.

Dynamic Load Balancing and Disaster Recovery

As server workloads vary, virtualization provides the ability for virtual machines that are over utilizing the resources of a server to be moved to underutilized servers. This dynamic load balancing creates efficient utilization of server resources.

Disaster recovery is a critical component for IT, as system crashes can create huge economic losses. Virtualization technology enables a virtual image on a machine to be instantly re-imaged on another server if a machine failure occurs.

Virtual Desktops

Multinational flexibility provides seamless transitions between different operating systems on a single machine reducing desktop footprint and hardware expenditure.

... Parallels Desktop for Mac, a [virtual machine](http://en.wikipedia.org/wiki/Virtual_machine) application. Instead of Boot Camp's dual-boot approach, Parallels Desktop runs Windows XP directly on the Mac OS desktop (in what Parallels calls "near-native performance")—allowing you to run both OSs simultaneously and switch back and forth seamlessly." Daniel A. Begun, CNET: [Heresy: Windows XP performance on a Mac](http://reviews.cnet.com/4531-10921_7-6546370.html) (http://reviews.cnet.com/4531-10921_7-6546370.html).

Improved System Reliability and Security

Virtualization of systems helps prevent system crashes due to memory corruption caused by software like device drivers. VT-d for Directed I/O Architecture provides methods to better control system devices by defining the architecture for DMA and interrupt remapping to ensure improved isolation of I/O resources for greater reliability, security, and availability.



...adopt virtualization for many reasons: collections of inefficient servers can be replaced with fewer machines; software can in harmless virtual partitions; and data centers can gracefully (and virtually) conform to shifting work models, new jing corporate priorities.

IT management will be based on virtual computing. Intel VT makes it possible to maximize computer utilization while id overheads of management, power consumption, maintenance and physical space.

nology provides a comprehensive roadmap to address virtualization challenges and includes support for CPU and I/O ng VMM ecosystem. Intel was the first and is the leading provider of hardware support for virtualization technologies.

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ticles/intel-virtualization-developer-community/

it: Special issue on virtualization technology, Volume 10, Issue 03: <http://www.intel.com/technology/iti/technology/iti/>

led Execution Technology for safer computing, formerly code named LaGrande Technology: Intel® Trusted Execution [intel.com/technology/security/](http://www.intel.com/technology/security/) (<http://www.intel.com/technology/security/>)

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[Standards & Initiatives](http://www.intel.com/standards/index.htm) (<http://www.intel.com/standards/index.htm>)

Technical book from Intel Press: Applied Virtualization Technology by Sean Campbell and Michael Jeronimo: http://www.intel.com/intelpress/sum_vpio.htm (http://www.intel.com/intelpress/sum_vpio.htm)

[Technology & Research](http://www.intel.com/technology/index.htm) (<http://www.intel.com/technology/index.htm>)

About The Author

Thomas Wolfgang Burger is the owner of Thomas Wolfgang Burger Consulting. He has been a consultant, instructor, writer, analyst, and applications developer since 1978. He can be reached at twburger@gmail.com (<mailto:twburger@gmail.com>).

[1] PCI SIG approved the new Address Translation Services spec as of February 15, 2007. See: I/O Virtualization Address Translation Services 1.0 specification at www.pcisig.com/specifications/iov/ats (<http://www.pcisig.com/specifications/iov/ats>)

For more complete information about compiler optimizations, see our: [Optimization Notice](http://en-us/articles/optimization-notice#opt-en) (en-us/articles/optimization-notice#opt-en).

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