Abstract
The successor to Microsoft Virtual Server 2005, Microsoft Virtual Server 2005 R2, is now available. This document describes the innovations made to the R2 version and provides an overview of the performance.

Contents
Introduction ................................................................. 2
Overview of Microsoft Virtual Server 2005 ................................................................. 2
Innovations in the Microsoft Virtual Server 2005 R2 version ........................................ 3
Performance ................................................................. 5
  CPU / Memory ................................................................. 5
  Disk ........................................................................ 6
  Network ................................................................. 7
  64-bit .................................................................. 7
Conclusion .................................................................. 8
Outlook .................................................................. 8
Literature .................................................................. 9
Contact .................................................................. 9
Introduction

Microsoft Virtual Server 2005 is a virtualization solution from Microsoft that has been available for about a year. It enables virtual machines to be operated on a Windows Server 2003. The successor, Microsoft Virtual Server 2005 R2 (R2 stands for release 2), is available for a short while now. Microsoft originally wanted to name the successor version of the Virtual Server 2005 “Microsoft Virtual Server 2005 SP1”. It was planned to make this version available as a free-of-charge service pack. However, as a number of new functions were integrated into the SP1 version, Microsoft renamed the version “Microsoft Virtual Server 2005 R2”, and provides it now as a fee required update.

An overview of the predecessor version of Microsoft Virtual Server 2005 is provided below as an introduction to this subject.

Overview of Microsoft Virtual Server 2005

Microsoft Virtual Server 2005 will be installed as an application on a Windows Server 2003, the so-called host operating system. The installation of the software generates a virtualization layer, which ensures access to the physical hardware of the host. This virtualization layer runs as a system service on the host operating system. A further task of the virtualization layer is to act as isolation between the host system, the virtual machines and also the VMs among each other. Isolation ensures secure separation between the VMs (virtual machines) and the host, even if one of the VMs crashes.

Microsoft Virtual Server 2005 is available in two editions:

- Standard Edition    (supports up to 4 processors on the host system)
- Enterprise Edition   (supports up to 32 processors on the host system)

Microsoft Virtual Server 2005 provides multiprocessor support on the host, whereas in contrast the individual virtual machines are single-processor-compliant, i.e. each VM provides a mono-processor system. In addition to the virtual server, other applications can also be run in parallel on the host operating system. In the virtual machines it is possible to use Microsoft Windows 2000 Server, Microsoft Windows Server 2003 or Microsoft Windows NT4.0 as the operating system.

Microsoft Virtual Server 2005 supports the memory provided by the physical server - with the effective size of the memory depending on the host operating system used. Microsoft Windows Server 2003 Standard Edition supports up to 4 GB and the Enterprise Edition up to 32 GB RAM on the host system. However, regardless of that a maximum of 3.6 GB RAM can be used by a VM.

The administration of Microsoft Virtual Server 2005 is web-based and requires the installation of the Internet Information Server. Via the administration web page it is possible to perform dynamic memory and computing capacity allocation for each virtual machine. The virtual machine has to be restarted for a change in memory allocation.

In the network sector, a maximum of four virtual network cards can be set up per VM. External communication from the virtual machines to the real server systems is via virtual network switches, which can be created via the web interface of the virtual server.

Microsoft Virtual Server 2005 can access the following disk memory technologies:

- IDE
- SCSI
- SAN
- NAS
Supported operating systems of Microsoft Virtual Server 2005

*Host operating system:*
- Windows Server 2003

*Operating systems of the virtual machines:*
- Windows NT 4.0 (with Service Pack 6a)
- Windows 2000 Server (all editions except for the Datacenter Edition)
- Windows Server 2003 (all editions except for the Datacenter Edition)

Innovations in the Microsoft Virtual Server 2005 R2 version

An overview of the most important innovations in the R2 version is shown below:
- In addition to the operating systems already released with the Microsoft Virtual Server 2005 version, the Microsoft Virtual Server 2005 R2 version also supports the following new operating systems:

  *Host operating systems:*
  - Microsoft Windows Server 2003 Enterprise Edition Service Pack 1
  - Microsoft Windows Server 2003 Datacenter Edition Service Pack 1
  - Microsoft Windows Server 2003 R2 Standard Edition
  - Microsoft Windows Server 2003 R2 Enterprise Edition
  - Microsoft Windows Server 2003 R2 Datacenter Edition
  - Microsoft Windows Server 2003 R2 Standard x64 Edition
  - Microsoft Windows Server 2003 R2 Enterprise x64 Edition
  - Microsoft Windows Server 2003 Standard x64 Edition
  - Microsoft Windows Server 2003 Enterprise x64 Edition
  - Microsoft Windows Server 2003 Standard SP2 (not for productive environments)
  - Microsoft Windows Server 2003 Enterprise x64 Edition (not for productive environments)

  *Operating systems of the virtual machines:*
  - Microsoft Windows Server 2003 Enterprise Edition Service Pack 1
  - Microsoft Windows Server 2003 R2 Standard Edition
  - Microsoft Windows Server 2003 R2 Enterprise Edition
  - Microsoft Windows Server 2003 R2 Datacenter Edition
  - Microsoft Windows XP Professional Service Pack 2
  - Linux operating systems (planned)

- 64-bit support
  - In addition to the Standard and Enterprise Editions, Microsoft Virtual Server 2005 R2 is also available in a 64-bit version.

- Virtual Disk Precompactor
  - The virtual disk precompactor enables the available free space of a virtual hard disk to be overwritten with zeros. This reduces the required hard disk space of the virtual hard disk on the physical disk.

- Performance improvements
  - Changes to the shadow page table administration
  - Improved guest process switching
  - Performance improvements for memory-intensive applications
  
  See the chapter [Performance](#)

- Network installation support
  - The network card of the virtual machines has been equipped with a PXE boot function. This enables installation to be performed via the PXE boot function straight from the virtual machine, thus making an additional PXE boot diskette no longer necessary for this purpose.
● Reservation of memory capacity for the Save State files of the virtual machines
  o With the R2 version, starting the virtual machine automatically creates an empty Save State file on the hard disk, which is the same size as the reserved memory of the virtual machine. Prior reservation of hard disk space ensures that the virtual machines can be switched to the suspend mode and that problems caused by too little memory capacity are a thing of the past.

● 64 GB RAM support on the host
  o On the host operating system the Microsoft Virtual Server 2005 R2 supports up to 64 GB main memory - depending on which Windows host operating system edition is installed.

● Virtual SCSI floppy disk with the guest operating system installation
  o In order to speed up the installation, an SCSI driver can be integrated during the installation routine of Windows Server 2003, Windows 2000 Server and Windows XP.

● Hyper-Threading support
  o With Virtual Server 2005, Microsoft recommended to disable Hyper-Threading. This is no longer necessary with the R2 version.

● iSCSI clustering support
  o Permits iSCSI clustering of virtual machines across various host systems.

● Cluster support for Virtual Server hosts’
  o Virtual Server hosts can be clustered using the cluster function (Microsoft Cluster Server) of the Windows Server 2003 Enterprise and Datacenter Edition.

● Error elimination
  o Various bug fixes

● Extended language support
  o In addition to the English language version, Microsoft Virtual Server 2005 R2 is also available in seven other languages (French, German, Spanish, Italian, Korean, and two Chinese languages).
Performance

One of the most important innovations in the Microsoft Virtual Server 2005 R2 compared with Microsoft Virtual Server 2005 is the improvement in performance.

In order to determine these improvements, comparative performance measurements were made with the Microsoft Virtual Server 2005 R2 version.

The performance measurements prospect the following three performance-relevant components.

- CPU / Memory
- Disk
- Network

For the analysis of these components, benchmark tools were used which are generally accepted in the industry and which enable the values determined to be compared with systems that have already been measured.

CPU / Memory

The “Standard Performance Evaluation Corporation” (in short SPEC) is an organization that has committed itself to developing and publishing standardized benchmarks for the evaluation of computer system performance. The leading companies of the computer industry, including Fujitsu Technology Solutions, are among the members of the SPEC consortium. One of the benchmarks published by SPEC is SPECcpu2000. SPECcpu2000 was developed to enable a performance comparison of systems during computing-intensive activity. The benchmark is split into two different test runs:

- CINT2000 for the measurement of system performance in integer operations
- CFP2000 for the measurement of system performance in floating-point operations

For a more detailed description of SPECcpu see:

The chart opposite shows the SPECcpu performance of a virtual machine from the Microsoft Virtual Server 2005 R2 version compared with a virtual machine from Microsoft Virtual Server 2005.

Significant growth in performance can be seen for both the integer and floating-point operations with the new R2 version.

For floating point operations (SPECfp_base2000) the performance improvement is 19%, for integer operations (SPECint_base2000) the improvement is 4.5%.
Disk

Disk I/O speed was examined using the Iometer measurement program. Iometer is an Open Source software tool ([http://www.iometer.org](http://www.iometer.org)) which is used to determine the performance data of storage systems with different block sizes and access patterns.

The chart opposite shows that the throughput in MB/s (per VM) was not improved by using the R2 version.

Significant is the reduction in CPU load of 22% with the same throughput (see diagram on the right). The virtual machine is put under less load and can make the saved computing power available to other services within the VM or to the Virtual Server 2005 R2 host system. The overall performance of the Microsoft Virtual Server 2005 R2 system is greatly improved by this saving.
Network

The network performance was measured using the load simulation tool Netperf ([http://www.netperf.org](http://www.netperf.org)). With this tool, network data packages with various block sizes are transferred between two test systems (a sender and a receiver). Senders and receivers can run on one system or two different systems. Netperf measures the data throughput between the two partners with blocks of 2k, 4k, 8k, 16k, 128k, 256k and 512k.

Virtual Server 2005 R2 also shows performance improvements in the network environment. Compared with Microsoft Virtual Server 2005, the throughput values achieved in the tests are always higher - as shown below. The gain in performance varies depending on the TCP block size, e.g. with a block size of 4k the throughput was increased by approximately 71%. Also with larger block sizes, e.g. 512k, an improvement in throughput of 33% compared with the predecessor version is visible.

![Netperf Measurement - 1VM to Native Server](image)

64-bit

Microsoft Virtual Server 2005 R2 supports 64-bit technology on x64 hardware - with the operating system and the Virtual Server 2005 R2 running in 64-bit mode. However, since the virtual machines only provide a 32-bit environment, only 32-bit (guest) operating systems can be used. Initial measurements with the R2 version under 64-bit did not result in any significant differences in performance when compared directly with the R2 version on a 32-bit system. However, the virtual server benefits from 64-bit technology in a different way. The use of 64-bit mode enables more memory to be addressed than in 32-bit mode, which in turn benefits the host operating system. This enables the host to be equipped with more memory and consequently permits an increase in memory per VM. Through this the scaling of the virtual server is significant increased and the overall performance of the virtualization solution is improved.
Conclusion

Microsoft Virtual Server 2005 R2 extends the scope of Microsoft Virtual Server 2005 to include useful functions, e.g. PXE boot, iSCSI clustering and 64-bit support. Compared with its predecessor, this new version also offers notable performance improvements in all performance-relevant areas. Considerable increases in speed are to be noted in the processor, disk and network environments.

Outlook

Virtualization will become more and more important in future. Processor manufacturers, such as Intel and AMD, are attempting to improve the performance of virtualization solutions by optimizing and extending their hardware. One type of extension is the integration of virtualization technologies or virtualization instructions in processors, as implemented for example by Intel in its Virtualization Technology (VT) or by AMD in its Pacifica Technology. In order to be able to make use of these hardware functions the software must be adapted to them. The support for this technology is likely to be available with the successor version of the Microsoft Virtual Server 2005 R2 and with the upcoming Windows version (code name Longhorn).
Literature

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http://www.primergy.com

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