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Windows 2008 Best Practices in VMware

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- Service Pack 2
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Additional Support

- SMP – full support on ESX 3.5 U2, ESX 3.5 U3, 3.5 U4, 4.0
- **pvscsi storage adapter** – supports all Windows Server 2008 releases
- **vmxnet3 network adapter** – supports all Windows Server 2008 releases

Support Considerations

The **Server Core** role available in the Standard, Datacenter, and Enterprise editions of Windows 2008 Server is supported by ESX. VMware Tools still apply, unless Server Core disables parts of the operating system that are specifically supported by VMware Tools. See the Microsoft Developer Network VMwareb site for more information about Server Core: http://msdn.microsoft.com/en-us/library/ms723891(VS.85).aspx

Full Support

R2 Datacenter – ESX 4.0- U1

R2 Enterprise – ESX 4.0- U1

R2 Standard – ESX 4.0- U1

R2 Small Business Server 2008 Standard – ESX 4.0

R2 Small Business Server 2008 Premium – ESX 4.0

R2 Essential Business Server 2008 Standard – ESX 4.0- U1

- **Fulfill these prerequisites before installing Windows Server 2008 in a virtual machine:**
- Be sure the virtual machine has at least 2GB of RAM.
- For the 32-bit version of Windows Server 2008, the hard drive for the virtual machine must be 16GB or larger.
- For the 64-bit version of Windows Server 2008, the hard drive for the virtual machine must be 20GB or larger.

- **Consider these support issues before installing Windows Server 2008:**
- If an Internet connection is not available while installing a 32-bit Windows Server 2008 guest, the driver for the **multimedia audio controller will not be installed**. The Windows Device Manager will indicate that the driver for the multimedia audio controller is missing. To install the required driver, configure an Internet connection, and run Windows Update on the Windows Server 2008 virtual machine.
- Windows Server 2008 **64-Bit Randomly Restarts** with Microsoft Update 932596
- If you install Microsoft Update 932596 on a computer running Windows Server 2008 64-bit, the computer randomly restarts and generates a Stop error. The Stop error might be 0x0000001E, 0x000000D1, or a different Stop error. See Microsoft KB article: http://support.microsoft.com/kb/950772 for details.

- The Microsoft KB article links to the Hotfix Request page where you can find a download to fix this problem: http://support.microsoft.com/hotfix/KBHotfix.aspx?kbnum=950772&kbln=en-us
-
- Note A Hotfix specifically for Windows Server 2008 is not listed on the Microsoft Hotfix Request page. HoVMwarever, the Hotfix for Windows Vista (Windows Vista All (Global) x64 sp2 Fix232207) will also fix this problem for Windows Server 2008.

- **Guest Customization**

- **Guest Customization is not supported in vCenter 2.5 Update3. This is general limitation with Sysprep version of Windows 2008. HoVMwarever below workarounds are available.**

a. **Change the Windows Guest OS to Windows Vista 32/64 bit for template and deploy VMs. After the VM is deployed change the Guest OS with Windows 2008 32/64bit.**
b. **Upgrade the vCenter version to 2.5 Update4 minimum.**

- **Alternate sysprep is strictly not supported.**

- In 3.5 VMware supports a max of 4 VCPU. From ESX 4 onwards VMware will be supporting 8 VCPU per VM.
- Why Single VCPU works better for Windows 2008, Because Windows 2008 uses high bit rate address space for context switching when compared with Windows 2003, which creates multiple cycles of high bit range contexts and these are better addressed by Single VCPU. (this again vary if it is a DB server).
- VCPU will get hit, when VMware have wide variety of hardware components attached to VM (Majorly Serial and Parallel COM ports, USB controllers, Sound Cards etc), if any of these components are not required, remove them and disable them from VM BIOS.
- Comment out USB dongles if any from Host conf file, this helps a lot in handling CPU interrupts for VMs, as major issues for performance comes from these add-ons on Host.
- Always check for **HAL/NTOSKRNL** version for VM, which confirms whether VMware are on right track. Windows 2008 HAL is similar to Windows 2003, no major difference has been done from Software vendor as done with Windows 2000.

DISKS

RDM:

SCSI Pass through (Physical) RDM has always been proven for performance, direct I/O, direct Pass through. SCSI Non – Pass (Virtual) through works better if VM I/O is limited in a single host across multiple VMs (Recommended for Windows 2008 in a clustered env).

Zeroed Thick:

Space required for the virtual disk is allocated at creation time, hoVMwarever the data blocks are not erased or zeroed out at the time of creation. (Recommended for Windows 2008 in a non-clustered env).

Eager Zeroed Thick:

Space required for the virtual disk is allocated at creation time. The remaining data blocks on the disk is zeroed out.

Thin Disks are not recommended at the moment, due to I/O dependability.

Do not check the box for independent persistent while creating the disk, as they are only meant for performance but other activities like hot cloning, hot migration may fail.

Page File Sharing

- For all Windows 32 bit version max page file can be of 16TB in PAE mode and 4GB in non-PAE mode. 64 bit max page file size of 16TB and supports up to 16 paging files where each must be on a separate volume. PAE is supported only on 32-bit versions of the Windows operating system; 64-bit versions of Windows do not support PAE.
- VMware recommends paging file to be placed onto a different drive with a different SCSI controller.
- Disabling a page file inside the guest will improve the performance, provided you make the VM to run with good amount of memory. Above this ESX host will create a default grow able swap in VM folder for flipping the memory balloon. (Not recommended when VM running with I/O intensive applications (Exchange, SQL etc)).
- Disabling a page file will initiate VM boot failure if sufficient amount of memory is not released at time of boot by host.
- A good standard for the memory overhead of each VM is 32 MB for the first 1 GB of virtual RAM plus another 8 MB for each additional GB of virtual RAM. This should be factored in the calculations of how many VMs to host on a physical server. The memory overhead varies depending on the actual load and amount of memory that

SCSI Controllers

- LSI logic SCSI controllers are recommended for Windows 2008 machines. Windows 2008 MSCS requires a SCSI-3 compliant mass storage controller, this is called as LSI Logic SAS controller in ESX 4.
- Till now VMware have been using SCSI-2 PR, from Windows 2008 onwards VMware will be using SCSI- 3 PR for Microsoft Clustering. SCSI -3 PR are completely supported by VMware.
- SAS controllers are usually shipped with Hardware Vendors depending on the model you purchase and they have been proven with Industry standards for SCSI compliance. (HP, Dell, IBM, SUN).
- If you are installing a Windows 2008 box with LSI Logic SAS controller it will prompt to install SAS drivers manually, and these drivers can be downloaded from HOST Vendor VMwarebsite.
- Windows Vista supports both Bus Logic and LSI Logic SCSI controllers and if you are installing Vista with a LSI logic controller a manual installation of Driver is required.
- Using separate SCSI controller for DB Drives (Exchange, SQL) for faster I/O. This is tested.

VSMP

VSMP (Virtual Symmetric Multi Processor) works better with single VCPU in Windows 2008 servers.

- CPU interrupts are shared betVMwareen multiple VCPUs if the Guest is running with multiple VCPU. CPU interrupts are scaled on per hardware basis, basically a daisy chain algorithm in Physical systems. Whereas in Virtual Guests the CPU interrupts are scaled on host privileged instruction virtualization.
- Also known as ring compression.
- In traditional systems
  OS runs in privileged mode
  OS “owns” the hardware
  Application code has less privilege
- VMM owns this privilege and allocate instruction codes to GUEST accordingly.
- From vSphere4 onwards VMware can pin CPU to AMD-V/Intel-V instruction sets on fly when VM is up and running. This plays a major role in guest and host CPU scheduling.

Interface Effects

-Disable background services such as SuperFetch and Windows Search. (Disable SuperFetch Service and Go to the properties of the C drive and uncheck the "Index this drive for faster searching" box, click apply and choose Apply changes to drive c:\ only).

-Disable scheduled tasks such as Scheduled Defrag.

-Disable AeroGlass and other user interface effects (Set the option to “Adjust for best performance” in System->Properties->Virtual Memory).

-Disable Screensaver and stick to classic theme.

-Disable personalized menu.

-Limit programs at startup (msconfig).

-Follow best/recommended practice for Antivirus program you are using from software vendor.

Database/Application Tuning

MS-SQL

Best practices for SQL server in VMware.

- Set a fixed amount of memory that the SQL Server process will use. For example, set the **max server memory** and **min server memory** equal and large enough to satisfy the workload (2500 MB is a good starting value).

- Configure SQL Server to Use Soft-NUMA - To avoid any performance latency resulting from remote memory accesses, you should size a SQL Server virtual machine's memory so it is less than the amount available per NUMA node.
http://msdn.microsoft.com/en-us/library/ms345357.aspx

Note: This should be applied only if it is applicable to your environment.

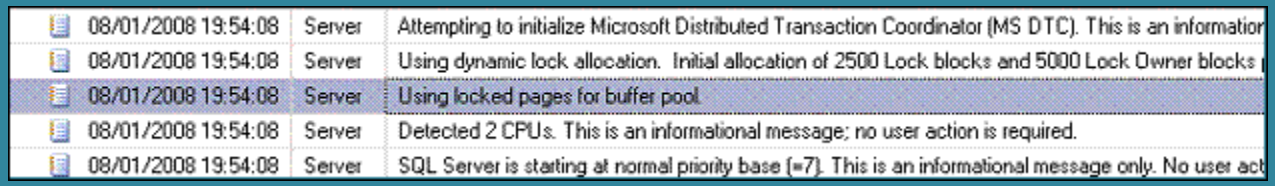
- If you set the SQL Server lock pages in memory parameter, make sure to set the virtual machine's reservations to match the amount of memory you set in the virtual machine

To set **Locked pages for SQL 2008** follow the below instructions:

a. Install the Cumulative Update (which requires you first install SQL 2008 SP1. Remember if you have not installed SQL Server 2008 yet, you can use slipstream support to install RTM, SP1, and CU 2 all in one setup execution).
b. Enable trace flag 845 as a startup parameter
c. Ensure the service account for SQL Server has the Locked Pages in Memory privilege set. This is not required if the service account is LOCAL SYSTEM.

http://support.microsoft.com/kb/918483

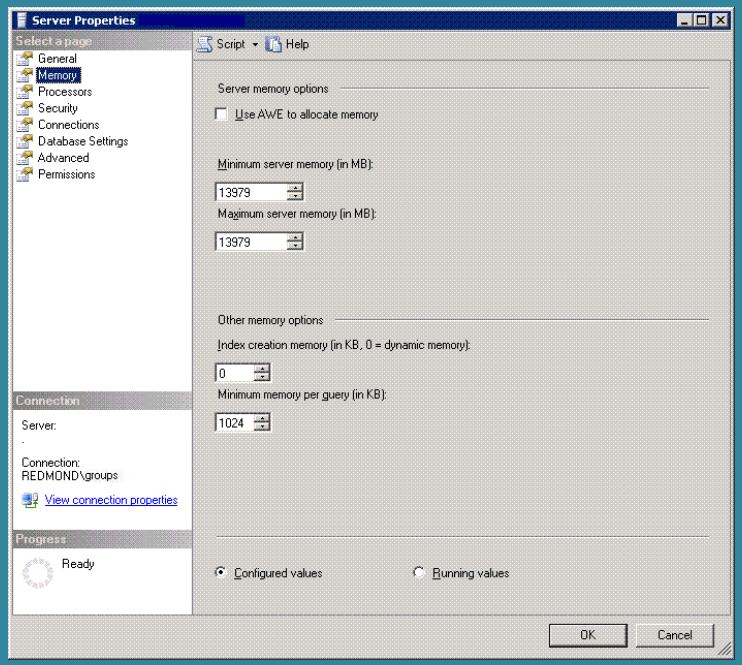
SQL error log entry when locked pages enabled. (x64)



08/01/2008 19:54:08	Server	Attempting to initialize Microsoft Distributed Transaction Coordinator (MS DTC). This is an informatior
08/01/2008 19:54:08	Server	Using dynamic lock allocation. Initial allocation of 2500 Lock blocks and 5000 Lock Owner blocks
08/01/2008 19:54:08	Server	Using locked pages for buffer pool.
08/01/2008 19:54:08	Server	Detected 2 CPUs. This is an informational message; no user action is required.
08/01/2008 19:54:08	Server	SQL Server is starting at normal priority base (=7). This is an informational message only. No user act

Local Computer Policy Settings

1. On the **Start** menu, click **Run**. In the **Open** box, type **gpedit.msc**.
a. The **Group Policy** dialog box opens.
2. On the **Group Policy** console, expand **Computer Configuration**, and then expand **Windows Settings**.
3. Expand **Security Settings**, and then expand **Local Policies**.
4. Select the **User Rights Assignment** folder.
a. The policies will be displayed in the details pane.
5. In the pane, double-click **Lock pages in memory**.
6. In the **Local Security Policy Setting** dialog box, click **Add**.
7. In the **Select Users or Groups** dialog box, add an account with privileges to run sqlservr.exe.



SQL Server can adapt its memory consumption to the workload. When the max server memory (MB) and min server memory (MB) parameters are set to the defaults (2147483647 and 0, respectively), SQL Server allocates memory dynamically within the range of the real memory. Use this setting for a dedicated database server that does not leverage AVMware.

NOTE: The aVMware enabled parameter is used to extend SQL Server Buffer pool beyond the virtual address space on 32Bit for high-end database servers. Address Windowing Extensions (AVMware) should not be used with any of the 64-bit platforms. AVMware administrated memory only can be used for data pages.

Boost SQL Server Priority to Increase Server Performance

You can enable the "Boost SQL Server Priority" option, to allow SQL Server threads to run in the real time priority class. When running at this priority level, SQL Server threads will be executed before all other process threads running in the loVMwarer variable priority class. This implies that on single processor machines under heavy load and not dedicated to SQL Server, other processes may not get enough attention. HoVMwarever, if the system is dedicated to SQL Server and disk I/O activity tends to be heavy, then you should enable this option to get substantial performance gains.

IMPORTANT: Do not use priority boost for clustered servers that are running SQL Server 7.0, SQL Server 2000, or SQL Server 2005 and later.

http://support.microsoft.com/kb/319942

How to configure:

http://msdn.microsoft.com/en-us/library/ms188709.aspx

Key Notes for MS-SQL in a VM:

-Use the VMXNET network adapter for optimal performance. The Enhanced VMXNET driver also supports jumbo frames and TSO for better network performance. To use the Enhanced VMXNET device you must explicitly select Enhanced VMXNET on the VI Client hardware configuration page.

- Aligning file system partitions is a VMwarell-known storage best practice for database workloads. Partition alignment on both physical machines and VMware VMFS partitions prevents performance I/O degradation caused by I/O crossing track boundaries.

-For SQL Server deployments using failover clustering, it is very important to use the eagerzeroedthick format when you create disks for virtual machines. By default, the VI Client and vmkfstools create disks in zeroedthick format. You can convert a disk to eagerzeroedthick format by importing, cloning, or inflating the disk. Disks you deploy from a template are also in eagerzeroedthick format.

MS - EXCHANGE:

Overview

Exchange 2007 on Windows 2008 in VMware is now supported, provided if it is Exchange 2007 sp1 and above.

Microsoft officially supports VMware ESX for running Microsoft Windows and major applications including Microsoft Exchange, SQL Server, and SharePoint Server. VMware ESX was the first hypervisor to be validated under the Microsoft Virtualization Validation Program (SVVP), providing customers who run Windows Server and Microsoft applications with cooperative support from Microsoft and VMware.

http://windowsservercatalog.com/svvp.aspx?svvppage=svvpsupport.htm

Get a free starter Kit from VMware to know more on Exchange Implementations in Virtual environment.
(http://vmware.com/resources/wp/ms_exchange_kit_register.html).

-By default, Exchange 2007 has a transport database cache size of 128 MB. Although this size may be sufficient for typical usage, a maximum database cache size of 128 MB may be insufficient on a Hub Transport or Edge Transport server that experiences higher than typical message rates or that experiences unexpected messaging loads. To better allow for cache growth, VMware recommend that the DatabaseMaxCacheSize value be increased from 128 MB to 512 MB on transport servers that have 4 GB or more of RAM.

http://technet.microsoft.com/en-us/library/dd789667.aspx

- Exchange 2003 is a heavy hitter in the storage area because of 4k disk block size, where Exchange 2007 uses 8k blocks and write coalescing (The coalescing write buffer is used in systems with a write-through L1 cache. Although the write buffer is conceptually in parallel with the L1 cache). With Exchange 2007 previous I/O challenges have been addressed.

http://msexchangeteam.com/archive/2005/08/10/408950.aspx

- Exchange supports a virtual processor-to-logical processor ratio not greater than 2:1. (http://technet.microsoft.com/en-us/library/cc794548(EXCHG.80).aspx)

Key Notes for MS-EXCHANGE in a VM:

1. All Exchange 2007 server roles, except for the Unified Messaging role, are supported in a virtualized environment.

2. Virtual disks that dynamically expand are not supported by Exchange.

3. Exchange supports a virtual processor-to-logical processor ratio no greater than 2:1. For example, a dual processor system using quad core processors contains a total of 8 logical processors in the host system. On a system with this configuration, do not allocate more than a total of 16 virtual processors to all guest virtual machines combined.

4. VMware recommends disk alignment for Exchange database.
With a physical disk that maintains 64 sectors per track, Microsoft Windows always creates the partition starting at the sixty-forth sector, therefore misaligning it with the underlying physical disk.
Setting the starting offset correctly will align Exchange I/O with storage track boundaries and improve disk performance. Microsoft Exchange Server 2007 writes data in multiples of 8-kilobyte (KB) I/O operations, and I/O operation to a database can be from 8 KB to 1 megabyte (MB).

Therefore, make sure that the starting offset is a multiple of 8 KB. Failure to do so may cause a single I/O operation spanning two tracks, causing performance degradation.

5. If you are running Exchange 2007 on a Windows 2003 box with basic disk, disk alignment is required.
http://technet.microsoft.com/en-us/library/aa998219.aspx

6. If you are running Exchange 2007 on a Windows 2008 box, no disk alignment is required. Windows Server 2008 automatically aligns the beginning of a partition to a 1,024 KB boundary.

7. Above this if VMFS partition alignment is done, no alignment should be performed on Virtual disk in view of Windows 2008 running with Exchange 2007 sp1.

Note: Diskpart can only be used with basic disks. Diskpart cannot be used with dynamic disks.

Disk / spindle count is a significant issue that relates directly to the balance betVMwareen designing for capacity versus throughput. Disk input/output rate (I/O per second, or IOPS) are a key design consideration for Exchange.

Clustering

Minimum Requirements and supportability.

Component	Single-Host Clustering	Multihost Clustering
Clustered virtual disk (.vmdk)	SCSI bus sharing mode must be set to virtual.	Not supported.
Clustered disks, virtual compatibility mode (non-pass-through RDM)	Device type must be set to virtual compatibility mode. SCSI bus sharing mode must be set to virtual mode. A single, shared RDM mapping file for each clustered disk is required.	Device type must be set to virtual compatibility mode for cluster across boxes, but not for standby host clustering or cluster across boxes on Windows 2008. SCSI bus sharing mode must be set to physical. Requires a single, shared RDM mapping file for each clustered disk.
Clustered disks, physical compatibility mode (pass-through RDM)	Not supported.	Device type must be set to Physical compatibility mode during hard disk creation. SCSI bus sharing mode must be set to physical (the default). A single, shared RDM mapping file for each clustered disk is required.
All types	All clustered nodes must use the same target ID (on the virtual SCSI adapter) for the same clustered disk. A separate virtual adapter must be used for clustered disks.	

Component	Requirement
Disk	If you place the boot disk on a virtual disk, select **Support Clustering Features such as Fault Tolerance** during disk provisioning. The only disks that you should not create with the `eagerzeroedthick` option are RDM files (both physical and virtual compatibility mode).
Windows	Use Windows Server 2003 SP2 (32 bit), Windows Server 2003 (64 bit) SP2, Windows 2000 Server SP4, or Windows Server 2008. Only two cluster nodes. Disk I/O timeout is 60 seconds or more (`HKEY_LOCAL_MACHINE\System\CurrentControlSet\Services\Disk\TimeOutValue`). **NOTE** If you recreate the cluster, this value might be reset to its default, so you must change it again. The cluster service must restart automatically on failure (first, second, and subsequent times).
ESX configuration	Do not overcommit memory. Set the **Memory Reservation** (minimum memory) option to the same as the amount of memory assigned to the virtual machine. If you must overcommit memory, the swap file must be local, not on the SAN.
Multipathing	Running third-party multipathing software is not supported.

Key Notes for a clustered VM:

-Still VMware support a max of two nodes in single host.

-Volumes created by ESX 3.5 and greater follow (minor version 31)

Block size 1MB	=> ~50TB
Block size 2MB	=> 64TB
Block size 4MB	=> 64TB
Block size 8MB	=> 64TB

-When using virtual disks for MSCS setup residing on VMFS data store, use 2MB block size for better disk I/O performance.

-Increase the queue depth of HBA's to increase the queue length for I/O's (Note: This completely depends on the Write – Back/ Write Through cache algorithm configured on SAN array).

-In an ISCSI SAN environment, enable Jumbo Frames if applicable to increase I/O performance on disk (look for specifics of MTU on vmkernel and vSwitch).

-Do not use virtual disks sitting on an extended VMFS data stores for MSCS setup, data recovery has been reported as the major issue for this kind of setup.

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