2161991 - VMware vSphere configuration guidelines

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Component	BC-OP-LNX-ESX (Linux on VmWare ESX)		

Please find the original document at **https://launchpad.support.sap.com/#/notes/ 2161991**

Symptom

You are setting up your server with VMware vSphere and you need some configuration recommendations.

Other Terms

Virtualization, VMware, Linux, SLES, RHEL, Microsoft, Windows, ESX, ESXi, vSphere

Reason and Prerequisites

VMware provides the following recommendations if you intend to run SAP applications on one of the supported vSphere versions.

You can find the supported SAP applications with the supported VMware vSphere version in the SAP Note 1492000 - General Support Statement for Virtual Environments.

Solution

Contents

SAP requires the configuration of the **Enhanced Monitoring in virtual environments** as described in SAP note 1409604 (Windows) and 1606643 (Linux).
To deploy an SAP environment with best performance and supportability on VMware vSphere, consider the guidelines below.

1 Recommendations for the ESXi Host

- *Use the latest processor generations*
  VMware highly recommends using the latest processor generations, due to their enhanced support for virtualization. Especially the features EPT (Intel Nehalem microarchitecture-based XEON and successors) and RVI (AMD 10h microarchitecture-based Opteron and successors) greatly enhance the performance of virtual machines.
- *Enable Hyper-Threading on the ESXi host*
  Hyperthreading (HT) changes in relation to the **Intel speculative-execution vulnerability CVE-2018-3646**, known as “L1 Terminal Fault” (not applicable to AMD) as follows:

Intel has posted details on a new class of CPU speculative-execution vulnerabilities. It may allow a malicious VM running on a given CPU core to effectively infer contents of the hypervisor's or another VM's privileged information residing concurrently in the same core's L1 Data cache. Because current Intel processors share the physically-addressed L1 Data cache across both logical processors of a Hyper-Threading (HT) enabled core, indiscriminate simultaneous scheduling of software threads on both logical processors creates the potential for further information leakage.

VMware has released a patch to mitigate the L1TF vulnerability. You can find all information related to the patch in VMware KB 55806. This patch introduces a new scheduler called 'ESXi Side-Channel-Aware Scheduler' which is not enabled by default. Enablement of this scheduler may impose a non-trivial performance impact on applications running in a vSphere environment. Customers should assess their environment to understand if their current environment has sufficient CPU capacity to enable the scheduler without operational impact. To identify VM's that may need to be reconfigured, VMware has released the HTAware Mitigation Tool. The tool details are described in VMware KB 56931.

VMware has conducted some initial testing to determine the performance impact of enabling the ESXi Side-Channel-Aware Scheduler on vSphere. Please see VMware KB 55767 for details.

- *Use VMware resource pools*
  Use resource pools to balance and limit available CPU resources across virtual machines. Avoid setting upper limits separately for each VM as this may result in increasing response times.

- *Deactivate BIOS power management in SMBIOS*
  Set the power management to "OS controlled" in the SMBIOS and use the vSphere power mode control feature in the host properties box instead. If the "OS controlled" feature is not present in the SMBIOS, deactivate any power management policies in the BIOS of the server.

2 Recommendations for the virtual machine

- *Install the VMware Tools*
  SAP support requires the VMware Tools to be installed inside the virtual machine.
  For the Linux guest OS: If you use the standard proprietary VMware Tools, which are part of the ESX server, you load modules, which taint the Linux Kernel. Although SAP Note 784391 prohibits using such modules, the use of the standard VMware Tools is tolerated and will be supported by SAP.
- *Plan the hardware resources for CPU and memory*
  Note: Before consulting SAP support with any performance related issue, ensure that CPU and Memory reservations are set. Configuration changes related to resource reservations do not require a restart of the VM.

  - *Related to Memory Over-commitment*
    Don't do memory over-commitment for performance-critical or productive SAP VMs!
    The SAP application allocates memory permanently and does not release it as long the application is running. To ensure that the VM with the SAP instance always has the full amount of memory available, set "Reserve all guest memory (All locked)" for the VM.
  - *Related to CPU Over-commitment*
    With VMware KB 55806, a new ESXi Side-Channel-Aware scheduler was introduced. VMware vSphere still allows over-commitment of available CPU resources, however, we did not yet fully test the impacts of the new scheduler with regards to over-commitment.
    Therefore, VMware recommends that customers review their current over-commitment level of the vSphere environment with respect to the utilization of the cores of the CPU and not of the

Hyper-Threads. Please review VMware KB 55767 for further information.
VMware recommends enabling the "CPU Reservation" only in case of performance problems of the SAP application, since the reserved CPU resources need to be available on other hosts when using DRS or VMware HA.

- *Take NUMA into account*
  For optimal VM performance, VMware recommends sizing the VMs within the NUMA node boundaries of the specific server system (CPU cores and local NUMA node memory). If a VM doesn't fit into the NUMA node (wide VM), use vSphere 5.x Virtual NUMA configuration, which reflects the underlying hardware. So-called wide VMs, which span a NUMA node, are fully supported.
- *Virtual Hardware Version of the VM*
  For optimal VM performance and full CPU feature support, the virtual VM hardware version must get aligned to the vSphere version. E.g. vSphere 5.5 VM virtual hardware version should get upgraded to version 10.
- *Configure your storage – recommendations for optimal performance*

  - *SCSI Controller*
    For optimal throughput, use the paravirtual SCSI Controller (PVSCSI).
    In case that your OS does not include a driver for the paravirtual SCSI Controller, you need to install the VMware Tools first, (for details, see VMware KB 1010398: http://kb.vmware.com/kb/1010398).
  - *SCSI Adapter*
    We strongly recommend using dedicated paravirtual SCSI adapters per VMDK file for database and VMs with high I/O load. The use of multiple virtual SCSI Controllers allows the execution of several parallel I/O operations inside the Guest OS. We also highly recommend separating the Log I/O traffic from the data file I/O traffic through separate virtual SCSI adapters. As a Best Practice, you may want to use one SCSI adapter for OS and Swap, one adapter for DB Log, and one or more adapters for DB data files (depending on the amount and size of DB data files). Please refer to the VMware Administration Guide on how to add additional virtual SCSI Controllers. Besides configuring multiple virtual SCSI adapters, ensure that the ESXi host has enough IO performance available (e.g. multiple physical array controllers, FC HBAs and that the storage array provides the sized IOPS capacity).
  - *Disk format*
    Virtual disks are created in "zeroedthick" format by default. This can lead to write performance degradation for the initial write to blocks on the file system. Therefore, the format "eagerzeroedthick" should be chosen. For details, review VMware KB 1022242: http://kb.vmware.com/kb/1022242. To determine which format a virtual disk currently has, consult VMware KB 1011170: http://kb.vmware.com/kb/1011170.
- *Configure your network*

  - Use vmxnet3 network cards to reach best network performance. For details, see VMware KB 1001805.
  - Consult the documents "Network I/O Latency in vSphere 5": http://www.vmware.com/resources/techresources/10256 and "Best Practices for Performance Tuning of Latency-Sensitive Workloads in vSphere VMs": http://www.vmware.com/resources/techresources/10220.
  - Ensure that the ESXi host is connected via multiple, redundant configured network cards to the network switch and that the network card bandwidth corresponds the needed network bandwidth if all VMs running on this host.
  - Please review the following SAP Notes for Network Interface Card (NIC) configuration: 1841151

- Windows Server 2012 (and higher) - different NIC order and 2109662 - Windows returns wrong IP address as source IP.

    - If you want to have the lowest latency possible, which will need more CPU overhead on the ESXi, read this SAP Note: 2015392 - VMware recommendations for latency-sensitive SAP applications.

- *What you should know about VMware snapshots and backups*

    - Snapshots are not a replacement of traditional backups. An active snapshot may affect negatively the IO performance of a VM.
      VMware does not recommend creating snapshots during peak times with high CPU and IO load on the system, as snapshots lead to increased IO activity. If you take a snapshot of a database VM during these peak times, you might see lost database connections of the application server because of increased IO activity.
    - When using VMware snapshots, consult VMware KB 1025279 (http://kb.vmware.com/kb/1025279).
    - Make sure that the virtual machine has no active snapshot when reporting performance problems.

3 Recommendations for the guest operating system

Follow SAP's rules for setting up file systems for your database installation. Distribute database files over different disks (VMDK files). Separate log and DB files. Use at least two separate VMFS (VMware file systems / data stores) volumes to create the needed virtual disks.

- **Windows**: For the installation and configuration of your SAP system, follow the deployment guidelines of SAP Note 1612283.
- **Linux:** Guidelines for all SAP supported Linux distributions:

    - For proper licensing SAP software running on Linux in a VM, configure a static, unique MAC address. Edit the MAC address of your network adapter to a manually set MAC address. The VMware Universally Unique Identifier (UUID) generates MAC addresses that are checked for conflicts. The generated MAC addresses are created by using three parts: the VMware OUI, the SMBIOS UUID for the physical ESXi machine and a hash based on the name of the entity that the MAC address is being generated for. After the MAC address has been generated, it does not change unless the virtual machine is moved to a different location. The MAC address in the configuration file of the virtual machine is saved. All MAC addresses that have been assigned to network adapters of running and suspended virtual machines on a given physical machine are tracked. The Mac address of a powered off virtual machine is not checked against those of running or suspended virtual machines. It is possible that when a virtual machine is powered on again, it can acquire a different Mac address. This acquisition is caused by a conflict with a virtual machine that was powered on when this virtual machine was powered off. This can lead to an invalid SAP license. Please refer to the VMware KB 507 for details: http://vmware.com/kb/507.
    - In order to avoid time synchronization errors we highly recommend to check the instructions mentioned in SAP note 989963. We also HIGHLY recommend using at least Novell SLES 9 and Red Hat RHEL 5.1 since they allow reducing the amount of timer interrupts. In general it is recommended using the latest SAP supported Linux distributions like SLES 11 and RHEL 6.x to avoid issues already solved in newer versions.

    - Set the scheduler to 'noop' (non-multiqueue) or 'none' (multiqueue) to disable the I/O scheduling. The VMware hypervisor has its own I/O scheduling mechanisms, therefore

scheduling I/O inside the Guest Operating System can cause unnecessary overhead. For details, see Red Hat KB http://kbase.redhat.com/faq/docs/DOC-5428 and SUSE KB http://www.novell.com/support/kb/doc.php?id=7009616 (applies also to other SLES versions than the mentioned).

- Choose the optimum SAP Memory Model for latest processor generations (see point 1.) we recommend to use the "std" memory model (es/implementation = std), which is the default from NetWeaver 7.10 onwards (SAP Note 941735). For older processors we highly recommend to use the "map" memory model (es/implementation = map). This memory model gives much better memory throughput on older processors than the "std" model (SAP Note 386605).

4 Recommendations and requirements for Virtual SAN (VSAN)

Only Virtual SAN 6.1 (vSphere 6.0 u1b) or newer versions are supported in production by VMware for SAP applications, like SAP NetWeaver platform-based products or SAP Business One. For a complete list of supported SAP applications please review SAP Notes 1492000 and 2161991.

Other 3rd party software-defined storage solutions running on vSphere must be supported by the vendors of those solutions. VMware requests that customers using such solutions directly work with the 3rd party vendors before escalating to VMware.

VMware Virtual SAN is embedded in the vSphere hypervisor and when enabled transparent for any OS or application running inside a VM. Nevertheless, an IOPS and capacity sizing for the used SAP application have to get performed. You can use the SAP Quicksizer Tool from SAP to perform such a sizing: http://service.sap.com/quicksizer.

Virtual SAN requires the usage of **VMware** and **SAP certified servers** and hardware components. Only certified servers and components are supported. For details please visit the

- VMware Virtual SAN server Compatibility Guide at: http://www.vmware.com/go/virtualsan-hcl or Virtual SAN component Compatibility Guide at: http://www.vmware.com/resources/compatibility/search.php?deviceCategory=vsan
- Use support note 1612283 (Windows) or support note 171356 (Linux) for a list of SAP certified hardware partners for non-SAP HANA applications.

For further information on SAP on VMware Virtual SAN (VSAN) check out: SAP on VMware Virtual SAN (vSAN)

5 Global Recommendations

Support for running ESXi/ESX as a nested virtualization solution (2009916)

VMware cannot currently assure production-grade reliability of a nested deployment and does not support this configuration.

In regard to all other aspects, like SAP sizing, backup & restore, HA and DR strategies, treat the SAP and database VMs as any other host. Follow the installation and tuning guidelines from SAP and the specific vendor for best results.

You can find Known Support Issues in Virtual Environments here.

Review SAP Community Network Wiki document for more information related to SAP on VMware.

Other Components

Component	Description
BC-OP-NT-ESX	Windows on VMware ESX

This document refers to

SAP Note/KBA	Title
1612283	Hardware Configuration Standards and Guidance
989963	Linux: VMware timing problem
941735	SAP memory management system for 64-bit Linux systems
784391	SAP support terms and 3rd-party Linux kernel drivers
386605	SAP Memory Management for Linux (32-bit)
2501545	Application fails due to error in opening VMware GuestLib
2293740	Performance degradation due to high network latency with vSphere 6
2109662	Windows returns wrong IP address as source IP
2015392	VMware recommendations for latency-sensitive SAP applications
1841151	Windows Server 2012 (and higher) - different NIC order
171356	SAP Software on Linux: General information
1606643	Linux: VMware vSphere host monitoring interface
1492000	General Support Statement for Virtual Environments
1409604	Virtualization on Windows: Enhanced monitoring
1374671	High Availability in Virtual Environment on Windows
1158363	VMware Performance Snapshot
1122387	Linux: SAP Support in virtualized environments

This document is referenced by

SAP Note/KBA	Title
2371520	SysLog entry “Unexpected return value 1 when calling up DbSlR”
2710614	Memory dumps in Virtual Environments
2017092	ZDATE_ILLEGAL_LOCTIME or ZDATE_LARGE_TIME_DIFF in VMWare environments.
2704067	SAP programs report intel_ssse3_rep_memcpy error
2291418	Error in DB rollback/SyFlush, return code 016384
1918647	PXA_NO_SHARED_MEMORY in Virtual Environments
2538919	VWware upgrade to version 6
2490017	Performance problem with VMware on Linux
2369910	SAP Software on Linux: General information
1409604	Virtualization on Windows: Enhanced monitoring
2393917	SAP HANA on VMware vSphere 6.5 and 6.7 in production
2414097	SAP Applications on IBM Cloud: Supported DB/OS and IBM Cloud Bare Metal Server Types
1409608	Virtualization on Windows
2428012	SAP on Nutanix
1374671	High Availability in Virtual Environment on Windows
1995460	SAP HANA VM on VMware vSphere 5.5 in production
2680466	How to protect SAP applications against L1 terminal fault exploit?
2501545	Application fails due to error in opening VMware GuestLib
2447884	VMware vSphere with VMware Tools 9.10.0 up to 10.1.5: Performance Degradation on Windows
1122388	Linux: VMware vSphere configuration guidelines
1309499	Hardware Capacity Analysis in SAP Services
1056052	Windows: VMware vSphere configuration guidelines
1158363	VMware Performance Snapshot
2015392	VMware recommendations for latency-sensitive SAP applications