



Virtualization of SAP Applications with VMware vSphere 5 on IBM eX5 enterprise systems

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1. Executive Overview

What is the motivation running SAP in virtualized environments? In the last decade SAP landscapes are growing and getting more and more complex. When we compare a SAP landscape in 2001 with today's SAP landscapes we see a growing number of applications which run on a dedicated server. To manage this multiple system landscape is a tremendous administrative effort. Systems management is often the largest and fastest-growing IT cost component when landscapes and infrastructure become more complex. Virtualization is playing a major role in driving improvements in these SAP landscapes. Servers that integrate features that enhance virtualization capabilities offer customers significant benefit.

While SAP landscapes are getting more complex, computing power, reliability, and management capabilities of IBM latest high end eX5 servers are also improving. In addition to the rock-solid and flexible virtualization capabilities of the x86 hardware, IBM also provides:

- Virtualization skills and services. IBM has longest experience in virtualization technologies, going as far back as the 1960s and the origin of virtualization itself.
- Deep SAP understanding and many years experience with virtualization of SAP environments on many platforms
- The right tools to manage different virtualization solutions and support consolidation for all IBM platforms

Virtualized SAP landscapes brings the benefit of:

- Higher server utilization with consolidation of multiple SAP instances
- Reduced maintenance costs
- Easier administration of the complete SAP landscape
- Enable higher levels of business continuity and disaster recovery
- Allows faster responsiveness to changing business demands.

In addition, virtualization technology helps improve the reliability, availability, and serviceability (RAS) features of a server.

This paper explains why and how to virtualize SAP implementations on an IBM System x3850 X5 server.

2. Product Introduction

The IBM System x server portfolio provides an ideal platform for SAP applications running virtualized in a private cloud environment. With multiple workloads running on the same server, performance remains important but reliability and availability become more critical than ever. Enterprise Servers with IBM's eX5 Technology are a key component in a dynamic infrastructure and offer significant new capabilities and features which address key requirements for virtualization solutions for SAP:

- Maximum memory with unique expansion capabilities
- Fast, integrated data storage options
- Extreme flexibility with FlexNode partitioning

Features and Benefits

- Chipkill memory to effectively recover from a failed DRAM module
- Memory Protection to enable a higher degree of data integrity
- Memory mirroring and DIMM rack sparing
- Advanced light path diagnostics that offer proactive problem solving and faster time to repair
- Integrated Management Module (IMM), which allows remote control access to manage, monitor, and troubleshoot
- Automatic Node Failover
- QPI Fail Down

IBM delivers selected models with VMware ESXi installed as an **embedded hypervisor**. ESXi is a thin hypervisor integrated into server hardware. The ESXi Server offers basic partitioning of server resources. However, it also acts as the foundation for virtual infrastructure software, enabling VMotion, DRS, etc. the keys to the dynamic, automated data center.



Figure 1: *Embedded Hypervisor*

The embedded hypervisor allows customers to easily deploy a virtualized environment as soon as they boot their system. It brings virtualization to customers that may not have all the resources or know-how to deploy a virtualized solution. The solution is based on a USB interface that comes with a protective interposer card that locks the mechanism into place, securing it in transport.

IBM eXFlash is an eight solid state drives (SSDs) enclosure for the x3850 X5 and x3950 X5. Each eXFlash can be put in place of four SAS or SATA disks. The x3690 X5 can use three eXFlash each with eight 1.8-inch solid state drives. IBM eXFlash offers high IOPs database performance with 480k internal IOPs for up to 200x local database performance over traditional spinning disks and potential for up to \$1.3M savings in equal IOPs external storage.

The new FlashPack offers high IOPs database performance with 480k internal IOPs for up to 200x local database performance over traditional spinning disks and potential for up to \$1.3M savings in equal IOPs external storage.

2.1 IBM system x3690 X5

IBM's eX5 product portfolio represents the fifth generation of servers built upon Enterprise X-Architecture. Servers with IBM's eX5 Technology are a major component in a dynamic infrastructure and offer significant new capabilities and features which address key requirements for customers with SAP landscapes.

The ability to modify the memory capacity independently of the processors, and the new high speed local storage options means this system can be highly utilized, yielding the best return from your application investment. These systems allow you to grow in processing, I/O, and memory dimensions, so you can provision what you need now, and expand the system to meet future requirements.

The IBM System x3690 X5 is a scalable 2U two socket system rack optimized server. The x3690 X5 is a system with the same benefits known from the flagship system x3850 X5.



Figure 2: IBM system x3690 X5

The IBM System x3690 X5 has the following features:

- 2x Intel Xeon E7 2800/4800/8800 series (up to 10 core) or 2 x Intel Xeon 7500 or 6500 families (up to 8-cores)
- 32 to 64 DDR3 DIMMs
 - o 16 DIMMs on the system planar / max. 256 GB
 - o 32 DIMMs with optional memory mezzanine /max. 512 GB
 - o 64 DIMMs with optional MAX5 and memory mezzanine /max. 1024 GB
- 2.5" HDDs or eXFlash with 1.8" SSDs with M5015 Controller
- RAID 0/1 Std, Opt RAID 5
- 2x 1GB Ethernet
- 2x 10 Gb Ethernet ports (standard on some models & optional)
- integrated virtualization on internal USB socket
- IMM, uEFI, and IBM Systems Director

We position the x3690 X5 for SAP Large Application Servers and SAP Distributed Applications. Often CPUs are not the limitation for virtualized SAP systems. SAP Virtualization solutions depends on memory capacity of its host systems. Memory over commitment leads to a dramatic performance loss for a virtualized SAP system. In a productive environment this over commitment is not allowed. With MAX5 memory expansion the overall systems can scale up without adding additional servers or licenses.

Memory Access for eX5, shortened to MAX5, is the name given to the memory scalability subsystems that can be added to eX5 servers. Memory Access for eX5 (MAX5) is a Memory expansion that can be added to eX5 servers. MAX5 for the rack-mounted systems (x3690 X5, x3850 X5 & x3950 X5) is in the form of a 1U device that attaches below the server.

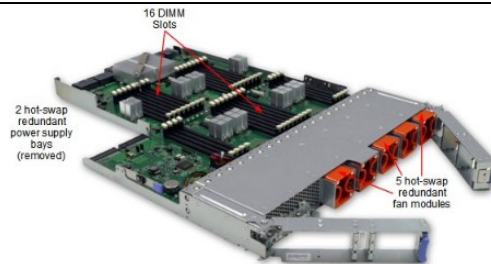


Figure 3: Memory Access for eX5

For the BladeCenter HX5, MAX5 is implemented in the form of an expansion blade. For Memory scaling the MAX5 Memory Expansion offers 32 DIMMs of extra memory capacity and extra memory channels. MAX5 Memory Expansion offers:

- Memory scaling independently of processors, adding 32 DIMMs of extra memory capacity and 16 extra memory channels for no compromises
- 50% more virtual machines and leading database performance over competitor 4-socket systems
- Lower cost, high performance configurations reaching desired memory capacity using less expensive DIMMs

The x3690 X5 and MAX5 supports memory configuration up to 2 TB with Samsung's Green DDR3 Memory 32GB DIMMs in a 2 socket system.



Figure 4: x3690 X5 + MAX5 2 socket - 2 TB

With a two socket system with MAX5 it is possible to host memory intensive SAP virtual machines with 40 virtual CPUs and 2 TB of memory. With this system IBM has a unique configuration for SAP Private Cloud & Virtualization solutions with an unbeatable price performance ratio.

IBM and Samsung deliver energy efficient virtualization platforms for VMware with IBM eX5 Servers and Samsung's ultra low power Green DDR3 1.35V memory. With the ability to extend the x3690 X5 to very large memory configuration with MAX5 in only 3U we use this system as base of SAP in memory computing engines (e.g HANA).

Found more info for the IBM System x3690 X5 on 'IBM System x at-a-glance guide':
<http://www.redbooks.ibm.com/technotes/tips0818.pdf> and in the 'x3690 X5 Data Sheet':
<ftp://public.dhe.ibm.com/common/ssi/pm/sp/n/xsd03061usen/XSD03061USEN.PDF>

2.2 IBM System x3850 X5

IBM System x enterprise servers are the ideal platform for business-critical and complex SAP applications—such as database processing, customer relationship management and enterprise resource planning—and highly consolidated, virtual server environments. With multiple workloads running on the same server, performance remains important but reliability and availability become more critical than ever. Servers with IBM's eX5 Technology are a major component in a dynamic infrastructure and offer significant new capabilities and features which address key requirements for customers with SAP landscapes.



Figure 5: IBM system x3850 X5

The x3850 X5 is a leadership high end scalable system that offers:

- Up to 3x SAP application performance
- 3.3x greater database performance and 3.6x more virtual machines than industry leading 2-socket x86 (Intel® Xeon® 5500 Series processor) systems
- Scaling via QPI from 4-socket, 64 DIMMs to 8-socket, 80 cores, 128 DIMM performance (192 DIMMs with MAX5)

The IBM System x3850 X5 has the following features:

- Four Xeon E7 2800/4800/8800 series (6 core/8 core/10 core) or Xeon 6500/7500 series
- Scalable to eight sockets by connecting two x3850 X5 servers together
- 64 to 96 DDR3 DIMMs
 - o Up to eight memory cards can be installed, each with eight DIMM slots (64 total)
 - o MAX5 adds 32 DIMM sockets
- 7 x PCIe 2.0 slots + PCIe 2.0 slot for supported RAID card.
- Up to 8x 2.5" HDDs or 16x 1.8" SSDs
- RAID 0/1 Std, Opt RAID 5
- 2 x 1GB Ethernet
- 2 x 10GB Ethernet (opt.)
- integrated virtualization on internal USB socket
- One Emulex 10Gb Ethernet dual-port adapter (except ARx models)
- IMM & uEFI

Two x3850 X5 servers can be connected together to form a single-system image with up to eight processors and up to 2 TB of RAM with cheaper 16GB DIMMs (compared to a 32GB option).



Figure 6: x3850 X5 - eight socket

The new ESXi 5 hypervisor supports up to 160 Logical CPUs and 2 TB of RAM as a maximum configuration. This processing capacity is ideal for extreme workloads of SAP Database & applications server, compute-intensive SAP Workloads.

With these features, the x3850 X5 high-end servers are the optimal platform for large-scale server consolidation projects and virtualization of multiple CPU intensive SAP instances. They enable larger system resource pools to support more simultaneously peaking virtual machine applications, using the load-balancing features of virtualization solutions.

New levels of innovation include superior energy management tools. IBM Systems Director Active Energy Manager™ is designed to take advantage of new processor features, enabling balanced system performance according to the available energy input. With Active Energy Manager, one can plan, predict,

and cap power consumption based on the hardware configuration, reducing infrastructure requirements for redundancy and potentially lowering the support costs of multiple application services as required by complex SAP solution landscapes.

Found more info for the IBM System x3850 X5 on 'IBM System x at-a-glance guide':
<http://www.redbooks.ibm.com/technotes/tips0817.pdf> and in the 'x3850 X5 /x3950 X5 Data Sheet'
<ftp://public.dhe.ibm.com/common/ssi/ecm/en/xsd03054usen/XSD03054USEN.PDF>

2.3 VMware Virtualization on IBM eX5 enterprise systems

2.3.1 VMware vSphere5

With vSphere5 there is only the ESXi edition of the hypervisor available. ESXi Server is the product name of a thin virtualization layer that runs directly on x86 hardware without any operating system being involved. ESXi Server provides the environment for multiple virtual machines to run on a single x86 server. Its main task is to create the illusion for each virtual machine that it runs on its own set of hardware and maps those virtual hardware interactions to the physical hardware.

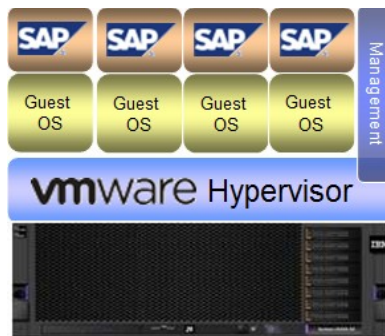


Figure 7: VMware Hypervisor

VMware vCenter is the key management component. It groups several ESXi servers together into a pool, called a cluster. vCenter provides a single management interface to all participating ESXi servers and represents a uniform view of its resources (see resource pools). It is also instrumental in providing Virtual Infrastructure Services, such as VMotion, high availability (failover protection) See *Figure 5* for further details of Virtual Infrastructure Services.

- VMotion enables the administrator to move a running Virtual Machine from one ESXi server to another without interruption to the end user. VMotion provides the basis for two more services, a load balancing service, called DRS (Distributed Resource Scheduling) and an energy-saving service called DPM (Distributed Power Manager). DRS uses VMotion as a mechanism to do load balancing across the available ESXi servers. DRS dynamically knows about the load condition (not only for initial placement of a VM) and, depending on the configuration of DRS, it either lists recommendations or actually performs the “relocation” of VMs to other ESXi servers, using VMotion.
- HA is a failover protection service for the entire virtual machine. In case a physical server (the ESXi server) fails, all the VMs that had been running on this ESXi server are restarted (rebooted) on the remaining ESXi servers.

VMware ESXi Hypervisor Facts

Host

- 64-bit VMkernel
- 2 TB host memory with IBM system x

- 160 logical CPUs (two node x3850 X5)
- 512 virtual machines per host
- USB 3.0 device support
- Host UEFI boot support

Virtual Machines

- 32-Way Virtual SMP (combination of sockets / cores)
- 1011 GB RAM
- Virtual Machine Hardware Version 8
- UEFI virtual BIOS

Networking

- Improved vNetwork Distributed switch
- Network I/O control

Management

- vCenter server appliance
- ESXi Firewall

Storage

- 2TB+ LUN support
- 64TB Raw Device Mapping
- improved Cluster File System - VMFS5
- Distributed Resource Scheduling for Storage
- Swap to SSD

Availability

- Host-based replication for Site Recovery Manager
- VMware High Availability

2.3.1.1 VMware vCenter

vCenter is the central management component in the VMware landscape. It groups several ESXi servers together into a pool. vCenter provides a management interface to all participating ESXi servers and represents a uniform view of its resources. This vCenter process runs on a dedicated Windows server and is controlled via the graphical management tool vSphere Client.

3. SAP Virtualization on System x servers with eX5 Technology

We use the scale up approach of virtualization with the high end servers which allows us to consolidate and optimize workload for environments with different Systems on one big server. The benefit comes from better hardware utilization and easier management of a centralized infrastructure.

Instead of using many small servers we choose the high end System x3850 X5 for virtualized SAP landscapes. The system x servers with eX5 Technology provide a rock-solid and flexible virtualization infrastructure.



Figure 8: Proof of Concept - Hardware

We have used the following hardware for this Proof of Concept

IBM system x3690 X5

- 2 x 8-core Xeon X7560 2.27 GHz processors
- 256 GB memory
- 2 x 1GB Broadcom NetXtreme & 2 x 10GB Emulex NICs
- 2 x 146GB internal SAS HDDs
- eXflash with 8 x 50GB SSD on MegaRaid M5015

IBM system x3850 X5 - (7145-AC1):

- 4 x 8-core Xeon X7560 2.27 GHz processors
- 160GB memory
- 2 x 1GB Broadcom NetXtreme II NICs
- 1 x HBA
- 2 x 146GB internal SAS HDDs
- Embedded Hypervisor

2 x IBM system x3650 M2 - (7947-62G):

- 2 x 4-core Xeon X5540 2.53 GHz processors
- 48 GB memory
- 2 x 1GB Broadcom NetXtreme II

- 8 x 300GB internal SAS HDDs
(1xHDD ESXi, 7xHDD RAID5 - VMFS)

We use an **IBM system x3650** as dedicated Management Server

Network

Each node is connected to the Lab network using two Gigabit Ethernet adapters (*Figure 10*). The advanced systems management (ASM) card (Remote Supervisor Adapter II) is connected to the same network for management access.

3.1 Setup of IBM system x host systems

The first step of the hardware setup is the update of the firmware to the latest level. We use the IBM bootable CD (BOMC) to update all firmware in a single step. Without updating firmware to the latest firmware level the installation process of the ESXi may fail.

3.1.1 Integrated Management Module

The web-based interface to the Integrated Management Module (IMM) allows a complete remote management of the server and gives a comprehensive overview of the system status. It helps provide:

- Easy for system administrators to manage large group of diverse systems
- Lower IT Cost
- Diagnostics, virtual presence and remote control to manage, monitor, troubleshoot and repair from any corner of the world (LightPath)
 - Manage servers remotely, in a secure environment independent Operating System state
 - Single Administrator can configure and deploy server from bare metal to Operating System boot
- Secure alerts and status, ensuring maximum uptime when used with IBM Systems Director
- Standards based alerting enables upward integration into wide variety of enterprise management environments "out of the box"
- Dedicated 10/100Mb Ethernet

With the remote control we were able to access the service console to insert the initial values for the ESXi™ Server after the first reboot. We used that interface to set up the two-node configuration. The event log shows whether there are any error conditions on the servers.

The x3850 X5 is equipped with an embedded hypervisor. On the x3690 X5 we install ESXi on a local disk with RAID5 on four internal SAS disks.

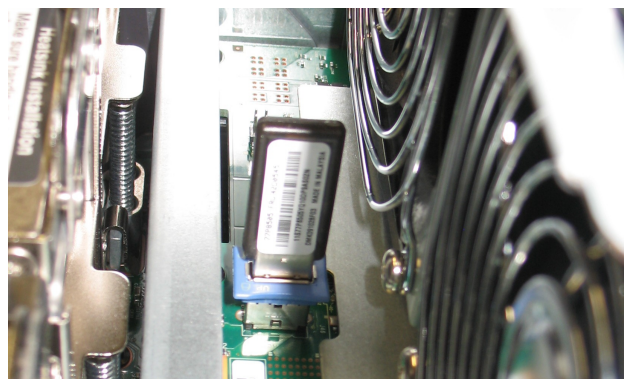


Figure 9: embedded hypervisor

We select the embedded hypervisor as a permanent boot device in the BIOS Setup. We start the system and select the setup option when prompted. We select "Embedded Hypervisor" as the first boot device and we check the BIOS to ensure that Intel VT technology is enabled.

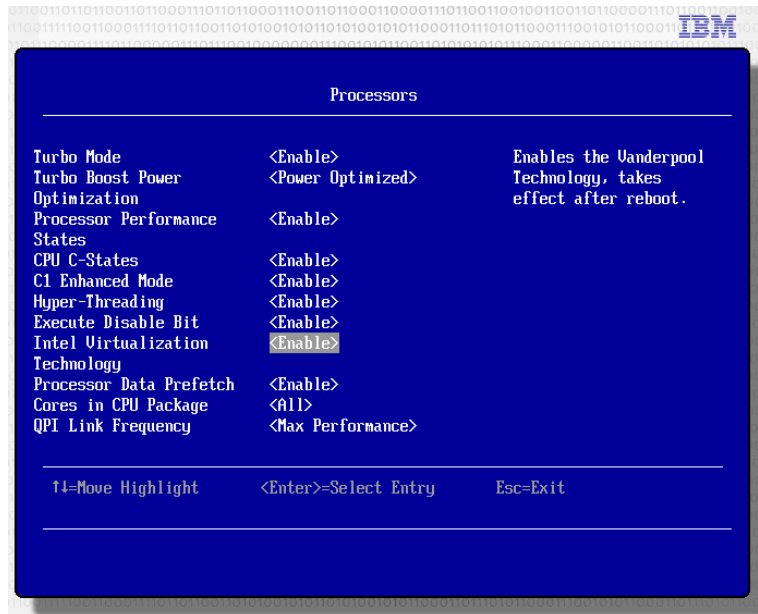


Figure 10: BIOS Setup

We use an Embedded Hypervisor on the x3850X5 and local harddisks in the x3690 X5. We install ESXi over the IMM on both systems.

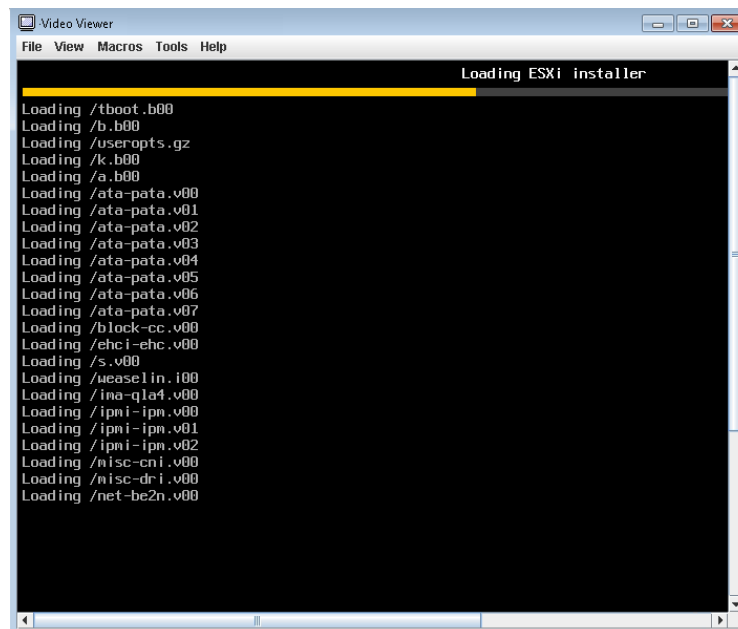


Figure 11: ESXi Installation

The ESXi server needs a basic configuration to get a connection via the network. The root password and keyboard layout is set in the installation process. We just have to insert the IP address and DNS configuration in the ESXi configuration panel at the server console. We used the remote console of the x3850 X5 integrated management module (IMM) for access to the server.

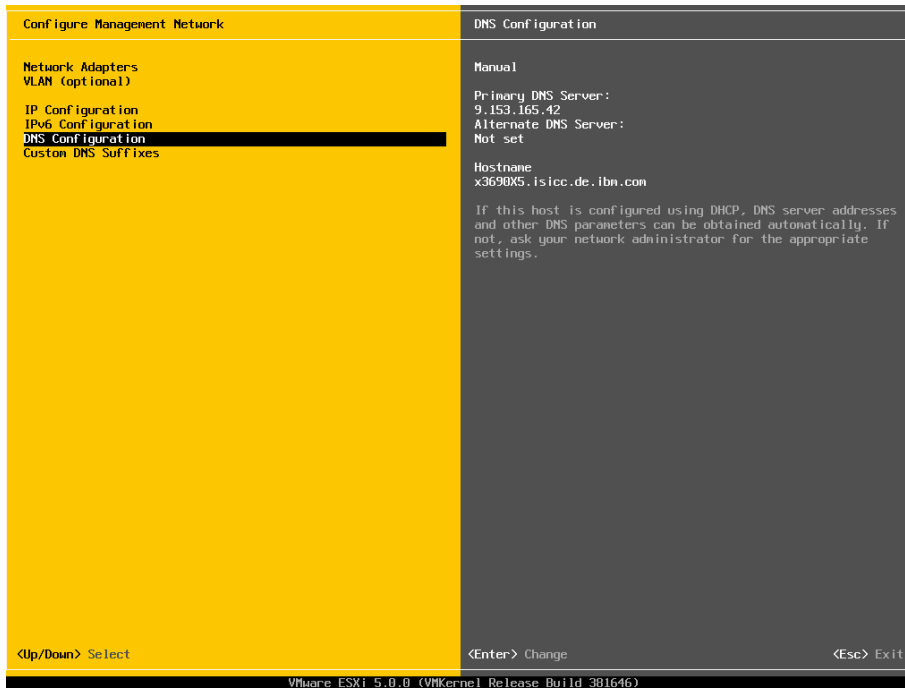


Figure 12: ESXi basic configuration

After the configuration we started the server and used it as standalone ESXi server. ESXi 5 now allows Host UEFI boot which speed up the boot process. After the installation process and reboot we select the ESXi image in 'Boot Option' – 'File Explorer'. We select the BOOTx64.EFI Image and insert a name that we can use to select the ESXi boot option in the boot order. With this new UEFI support the ESXi hypervisor starts immediately after the system initialization.

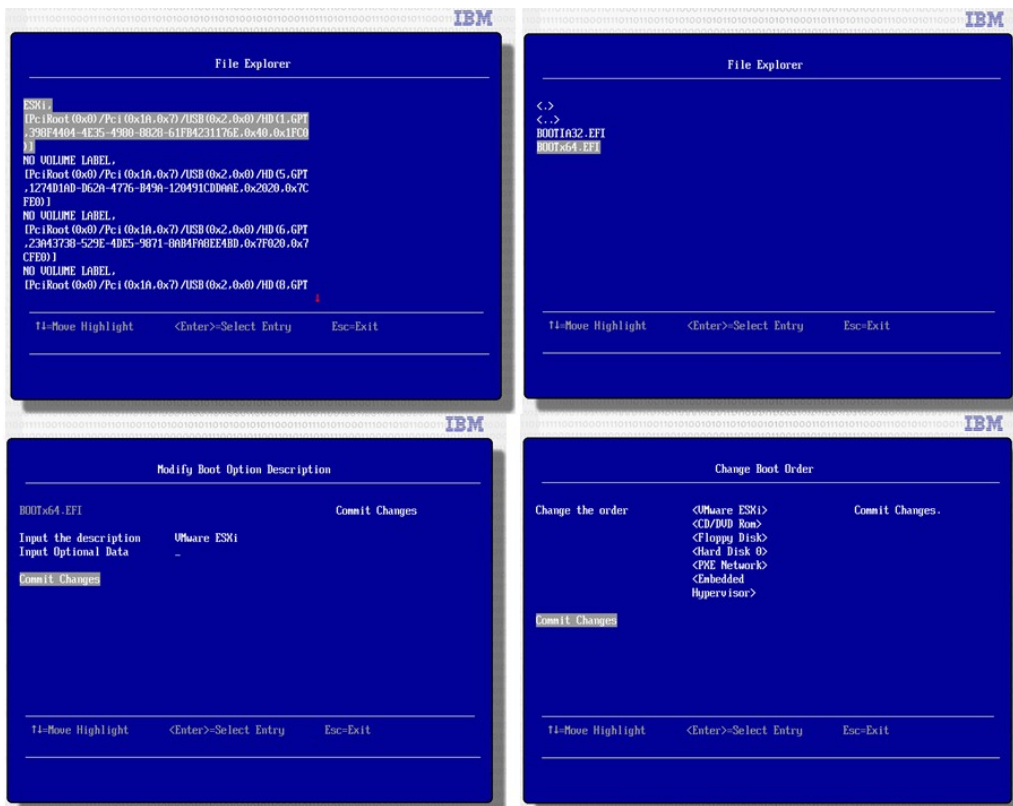


Figure 13: ESXi UEFI Boot

vSphere 5 allows UEFI boot of the virtual machine in the Boot option section in the Virtual Machine Properties.

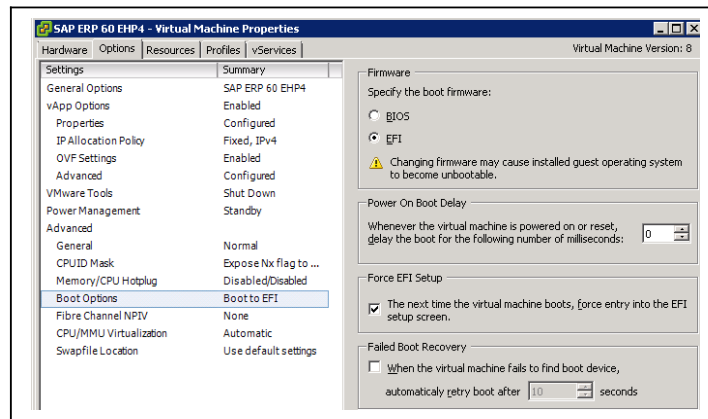


Figure 14: Guest UEFI Boot

This option can be used when installing UEFI enabled guest operating systems. The process of selection option can be modified inside a virtual machine with an UEFI Boot Manager.

3.2 Management of vSphere environment

We use a VMware vCenter Server 5.0 for a centralized management of all host systems. We use the approach to run vCenter in a virtual machine. We do not need a dedicated server for that management functionality. With vSphere 5 VMware provide a vCenter server appliance. This reduces the effort to install and configure an Operating System and vCenter product in a virtual machine.



Figure 15: vCenter Server 5.0

To connect to that management server, we use the vSphere Client on an administration workstation with Windows. To install the vSphere client on an administrator workstation we connect to the web interface of ESXi Server and download to vSphere Client Version 5.0.0. We add all ESXi hosts to the vCenter server. After successful setup, we will see the system information on the summary screen of the ESXi Server.

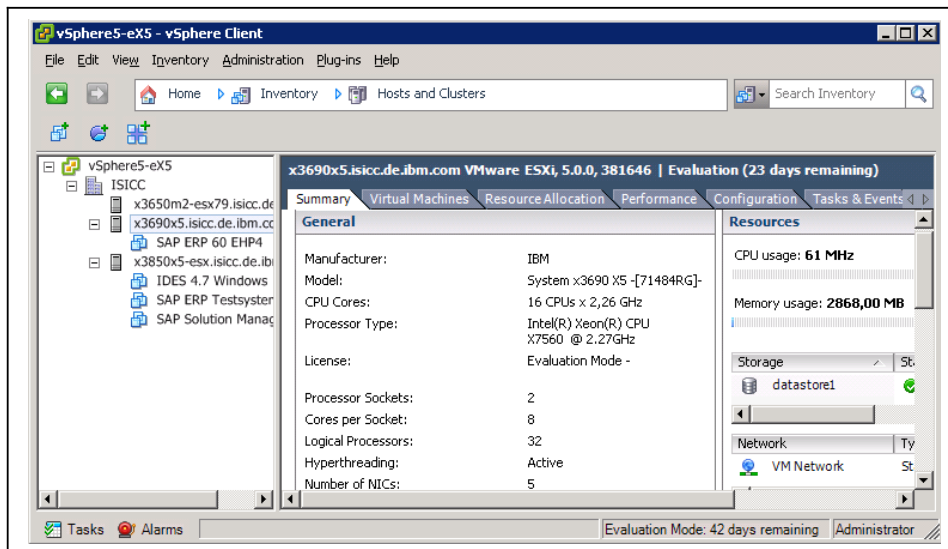


Figure 16: vSphere client summary screen

Papers describing best practices and setup information for ESXi Server and “Performance-tuning Best Practices for ESXi Server” can be found on the VMware Technical Resources page: <http://www.vmware.com/vmtn/resources/cat/91>. Be sure to follow the VMware® ESXi Server configuration guidelines (SAP Note 1056052). The IBM System x3850 X5 and System x3690 X5 Installation Guide can be found at: <http://www-03.ibm.com/systems/x/index.html>

3.2.1 Storage Configuration

The VMware ESXi Server File System (VMFS5) is a file system designed specifically for the storage of virtual machines. It is a cluster-capable shared file system, designed to format very large disk drives (LUNs, 2+ TB) and store the virtual machine .vmdk files, which can also be very large. These volumes store the following key data:

- Virtual drives of virtual machines: the .vmdk files
- VM description file: *.vmx
- The memory images from virtual machines that have been suspended
- Delta files in case snapshots of entire virtual machines are used

We use local disks and an iSCSI targets as common Datastore for all hosts.

First we add the eFlash SSD drives in a RAID5 as Datastore. We define an array in the MegaRaid M5015 Settings and add this virtual drive as Datastore. We select VMFS 5 to use the 2TB+ support for large SAP disks. With this combination of solid-state disk technology and high-speed controller we can use an extreme high-performance Datastore in this ESXi host system. We can use up three eFlash enclosure with up to 24 x 200GB SSDs. This gives us a raw capacity of 4.8 TB in a single 2U host system.



Figure 17: IBM eFlash

The x3690X5 supports another SSD based solution called Fusion IO. As of today there are no drivers for ESXi to access this alternative flash storage technology. The eXflash array is a unique IBM feature that can be used in the high end servers x3690X5 and x3850X5 that we use in this PoC.

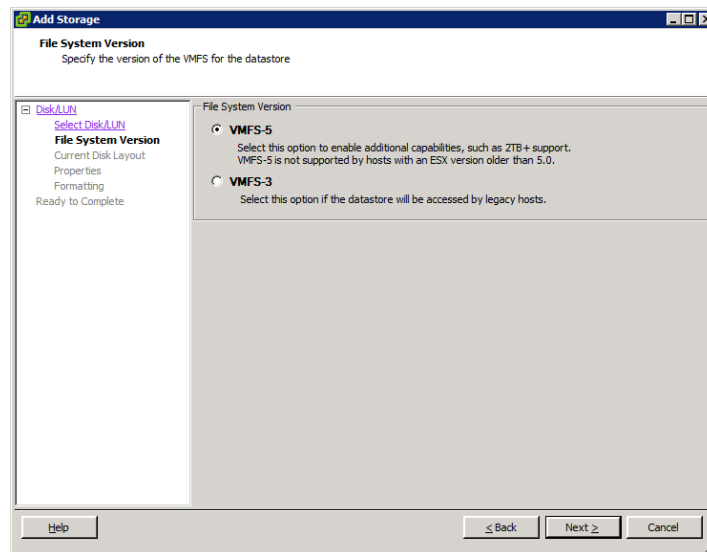


Figure 18: VMFS-5 Datastore

Beside the local disks we use a common Datastore located on an IBM XiV Storage system for all host system. This allows us to use live migration and HA scenarios with SAP virtual machines in the VMware landscape. We can use any SAP system on all host system when we use the Datastore on this storage system.

4. SAP landscape setup

In this PoC we setup an environment with an SAP ERP ECC system. The first step is the creation of a virtual machine and the installation of an operating system.

4.1 Virtual machine setup

The first step to run a SAP system in a virtual environment is the setup of a virtual machine that runs a supported operating system. VMware ESXi Version 5 adds some new features especially for virtualizing SAP application servers,.

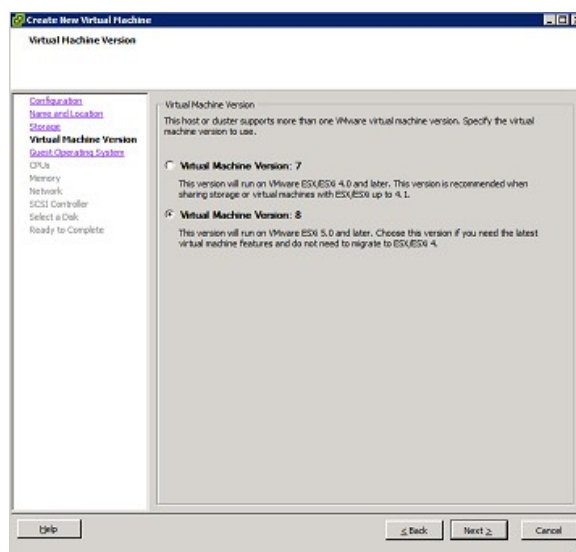


Figure 19: Virtual machine - Version 8

We now can use up to 32 virtual sockets and define the number of cores per socket and up to 1TB of memory per virtual machine. We use a VM configuration with 4 socket / 8 cores on the x3690X5.

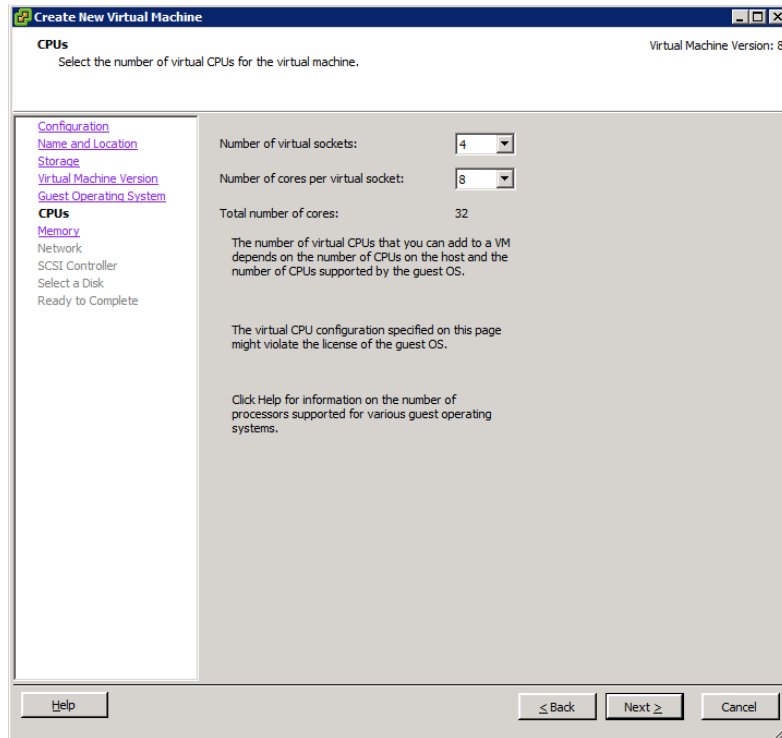


Figure 20: Virtual Machine - CPU

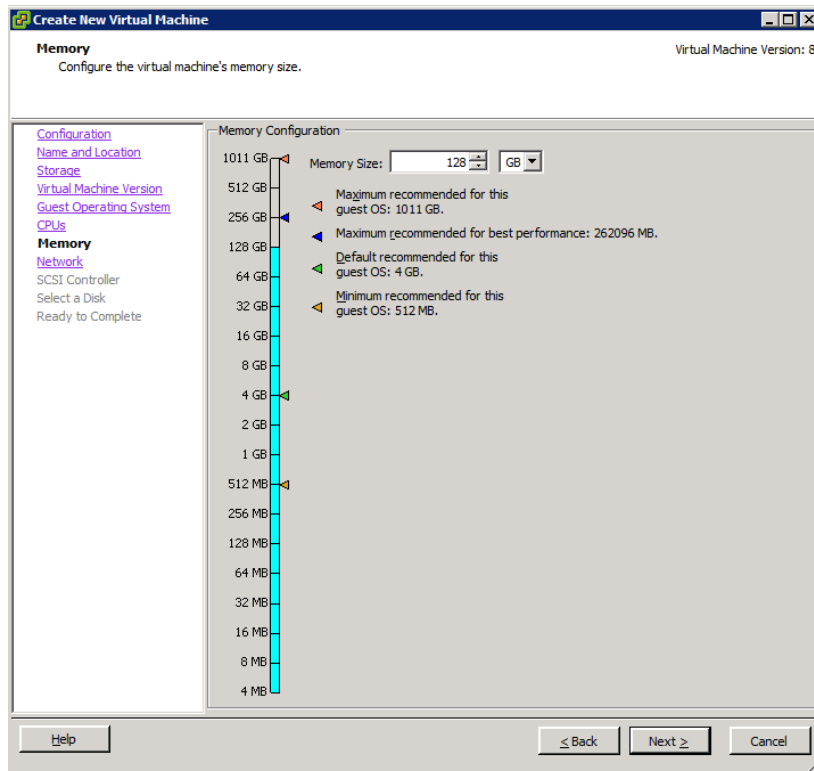


Figure 21: Virtual Machine memory

With those values for virtual processors and memory, a virtual machine is now better positioned to host SAP workloads. A virtualized Windows server now has enough processing power and memory for most SAP workloads.

We use the Datacenter version of the Windows Server operating system which supports a configuration with 32 CPUs. The installation process does not differ from the standard setup process and is not described in this document. The Enterprise & Data Center version of Windows Server allows adding memory without a reboot of the system. The Data Center version of Windows Server allows add CPUs in a running virtual machine

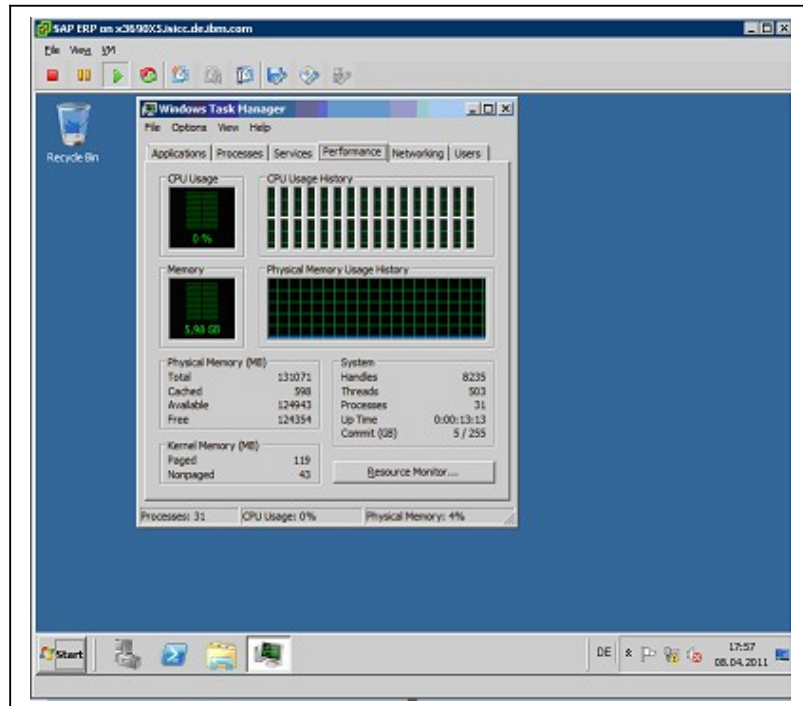


Figure 22: 32 virtual CPUs

After successful installation we can check the system configuration. The fastest way to check this and get an overview of the performance is the task manager. We can see 32 CPUs in this virtual machine.

4.2 SAP landscape setup

We have enough resources available to host several SAP systems on the x3850 X5. We will start with a Solution Manger. The next step is the setup of an ERP system. We will then clone this system to a development system for testing.

4.2.1 SAP solution manager

The starting point is the SAP Solution Manager. We use a virtual machine running a Windows 2008 server and run the SAPINST process of the solution manager 7.0. After successful installation we can login wit SAPGUI.

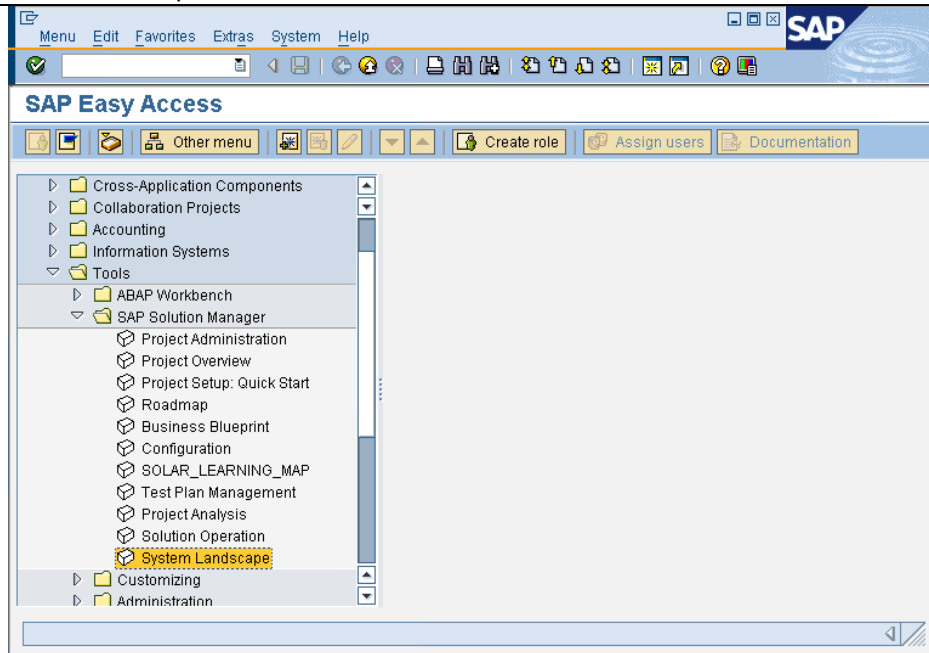


Figure 23: SAP Solution Manager - GUI

In this PoC we did not have a connection to the SAP marketplace, so we cannot use the full functionality of the SAP Solution Manager in this environment. We can use the Solution Manager for creation of installation keys for the SAP ERP systems.

4.2.2 SAP ERP

The installation process inside a VM differs slightly from an installation on a physical host (e.g. enhanced monitoring). You can follow the installation and tuning guidelines from SAP.

To Install SAP ERP 6.0 central system we followed the instructions from the SAP Installation Guides:

- Java® installation
- IBM DB2® database installation
- SAP Installation Master

See SAP Note Note 1409608 - Virtualization on Windows for configuration requirements.

We selected DB2 for Windows and installed a Central System with Central Services, a database instance and a central instance:



Figure 24: SAP installation

After the successful installation we start the system processes and bring some load to the new system

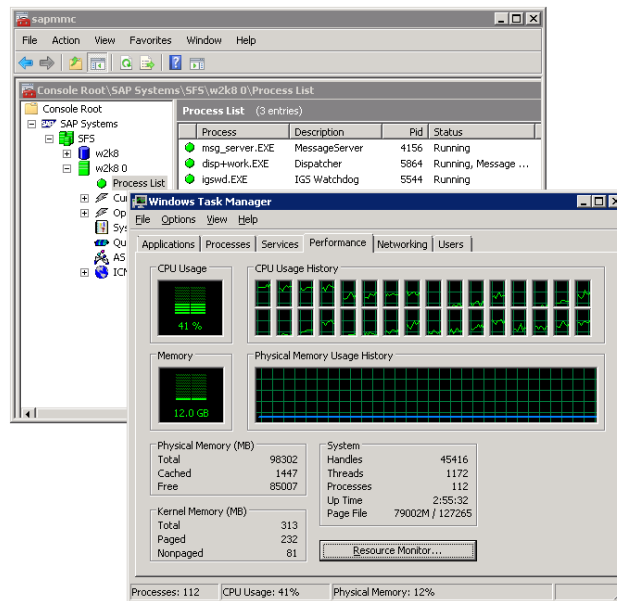


Figure 25: SAP system processes

We open the Operating System monitor with the OS07 transaction and can and entry for the CPUs and memory.

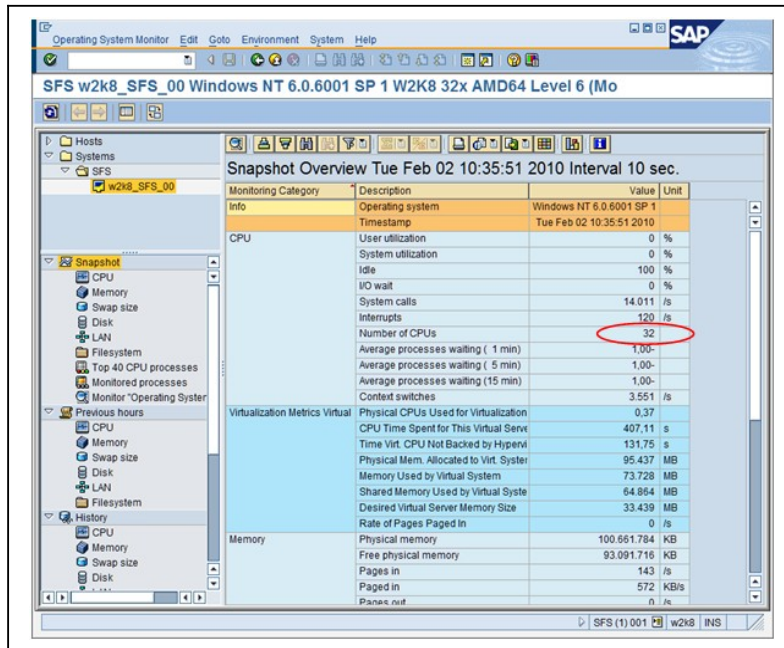


Figure 26: Operating System Monitor 32 vCPU

With the new capabilities of vSphere 5 we now can larger host SAP systems in a single virtual machine than this was possible with ESXi 4.1. We will see in the next chapter how we can migrate an existing SAP system to the new ESXi 5 host and how the SAP can leverage this new features.

4.3 Migration of SAP virtual machines from vSphere 4

This chapter describes the modification of an existing SAP virtual machine from a previous version of an ESX 4.1 host system. We clone a SAP ERP system from an existing installation to a VM for the Upgrade test.

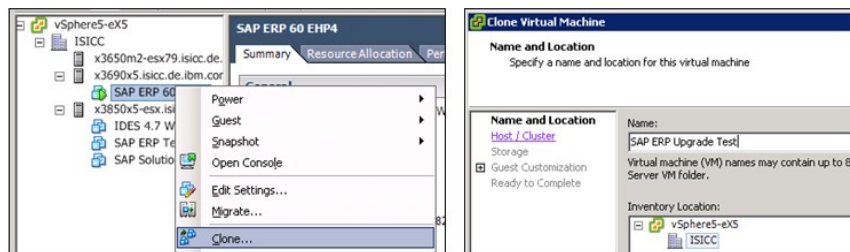


Figure 27: SAP VM Clone

Note that the clone process stresses the disk subsystem. This can be speed up with storage drivers which handle the copy process on the storage system.

We clone the 'productive' SAP from the x3690X5 to a test environment on a x3650M2 while the SAP system is running.

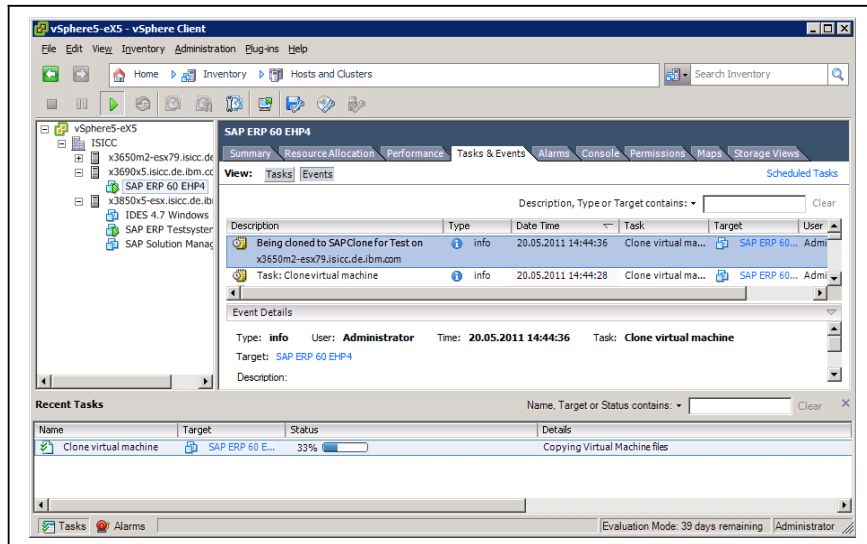


Figure 28: Productive SAP system cloning

When updating a host system to vSphere 5 the virtual machines on the data store can be used immediately after a reboot. These virtual machines have an older VM version 7 which does not allow the usage of the full functionality of the new hypervisor. In our test scenario we use a SAP ERP system that we created with vSphere 4 with the maximum of eight vCPU. The first step is the upgrade of Virtual Hardware.

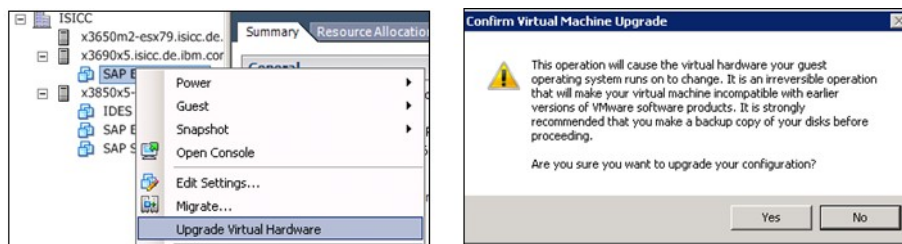


Figure 29: VM Upgrade

After restart we upgrade the VMware tools inside the virtual machine. The VMware tools are necessary to use SAPOSCOL and the enhanced monitoring in the transactions os07n. Add the library directory C:\Program Files\VMware\VMware Tools\Guest SDK\lib\win64 to the PATH variable in this virtual machine.

For 'virtualization aware monitoring' inside the SAP virtual machine we modify the ESXi server with vSphere 5 Client - Configuration - Advanced Settings - Misc and set value of Misc.GuestLibAllowHostInfo to '1'. We add parameter 'tools.guestlib.enableHostInfo' in the virtual machine setting - 'Options' - 'Advanced' - 'General' - 'Configuration Parameters' and set value 'TRUE'. See SAP Note 1409604 for more information about Enhanced monitoring

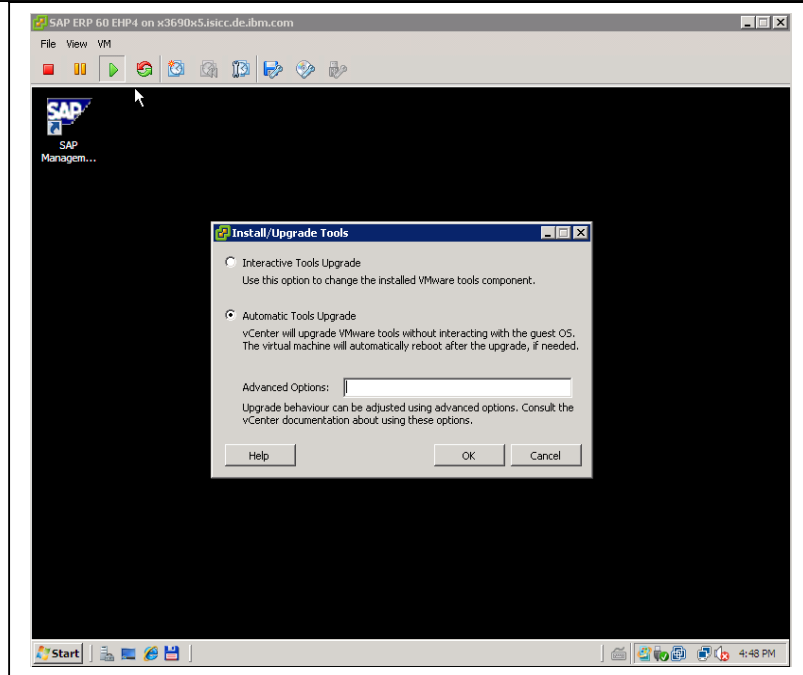


Figure 30: VMware Tools Update

With the new version 8 of the virtual machine we can use the new capabilities of vSphere 5 for migrated SAP virtual machines.

5. Conclusion

Based on fifth-generation Enterprise X-Architecture technology, the IBM System x3850 X5 is a highly scalable x86 server, designed to deliver innovation with features that enable optimal performance for consolidation and virtualized SAP environments. This Proof of Concept shows how you can use VMware virtualization solutions with these IBM eX5 enterprise systems to optimize your SAP infrastructure.

IBM System x servers and the VMware vSphere portfolio are high performance platforms for server consolidation of SAP enterprise applications. IBM offers a broad range of systems combined with IBM storage systems and services for creating a virtualized environment for SAP applications.

The new ESXi version allows configuration with up to 1 TB of memory for a SAP virtual machine. A large memory capacity is crucial for a SAP virtualization host system. MAX5 memory expansion significantly increases the system's memory capacity by supporting 32 additional memory modules per system.

The new hypervisor that comes with vSphere 5 supports up to 160 Logical CPUs and 2 TB of RAM as a maximum configuration. IBM eX5 servers provide a strong foundation and give customer the best solution for their needs. For memory intensive SAP workload the x3690X5 can provide a unique 2 socket system with a memory configuration with 2TB. This allows hosting memory demanding SAP workload in a dense package with unbeatable low power consumption.

With eXflash a single 2U x3690X5 provides an ultra fast solid-state disk array with up to 4.8 TB capacity. This allows us to host I/O intensive SAP systems on this high end x86 servers.

For CPU intensive SAP systems the x3850X5 can be configured as a two node system with 8 sockets and 2 TB with cheaper 16GB DIMMs. With the most powerful x86 Intel processors this system can consolidate several larger SAP systems with up to 32 virtual CPUs. The tests in this proof of concept shows that consolidation of SAP with vSphere with can be used to achieve better use of existing resources, allowing you to do more with fewer resources.

The combination of VMware virtualization solutions with the enterprise class x86 servers from the IBM system x family reduces systems management tasks to a minimum and delivers a flexible and high performance platform for SAP systems.