



# Siemens *syngo*<sup>®</sup> Dynamics on VMware<sup>®</sup> vSphere or VMware Virtual Infrastructure

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DEPLOYMENT AND TECHNICAL CONSIDERATIONS GUIDE

**Table of Contents**

Introduction.....	1
VMware and <i>syngo</i> <sup>®</sup> Dynamics Overview.....	1
Siemens <i>syngo</i> <sup>®</sup> Dynamics Overview.....	1
VMware vSphere or VMware Virtual Infrastructure .....	2
Siemens <i>syngo</i> <sup>®</sup> Dynamics Architecture and Deployment Strategy .....	3
Testing Process and Results .....	5
Testing Methodology and Overview .....	5
Hardware and Software Configuration.....	5
Virtual Machine Configuration.....	8
Workload Used .....	8
Results Observed .....	8
Additional Testing .....	8
Deployment Best Practices .....	11
Reference Architecture.....	14
Licensing .....	14
Technical Support .....	14
Conclusions.....	14
Resources .....	15
Appendix .....	15

## Introduction

This document provides direction to those interested in running Siemens *syngo*<sup>®</sup> Dynamics on VMware Infrastructure 3 or VMware<sup>®</sup> vSphere™ 4. It provides basic guidance on the architecture of Siemens *syngo* Dynamics, as well as the value of utilizing the VMware platform. The results of recent testing done jointly by VMware and Siemens are covered, where the performance and functionality of Siemens *syngo* Dynamics on VMware virtual infrastructure are characterized. Finally, some best practices for utilizing the two product sets together in your datacenter are outlined.

## VMware and *syngo*<sup>®</sup> Dynamics Overview

This section includes one to two paragraphs describing the solution and joint value proposition, including what business and technical issues the joint solution addresses: for example: cost containment, risk reduction, always-on availability, desktop environment portability, disaster recovery.

### Siemens *syngo*<sup>®</sup> Dynamics Overview

*syngo* Dynamics is a multimodality diagnostic image review, dynamic image processing, clinical reporting, and archiving system for cardiology. Bringing evidence based reporting to a new level, *syngo* Dynamics helps improve the efficiency of clinical procedures in the cardiology, vascular ultrasound, general imaging, and obstetrics/gynecology fields.

*syngo* Dynamics is a client-server system. Multiple client workplaces and acquisition devices are connected to one or more servers.

The *syngo* Dynamics server hosts

The database containing patient records, reports, the location of studies, the image cache and the report templates.

The *syngo* Dynamics server is responsible for collecting all studies produced by the acquisition machines, and making the studies and their associated images available to *syngo* Dynamics Workplaces.

The main services provided by the server are:

- Database service

This service manages the database and handles access to the database.

- Archiving service

Handles archive objects and implements storage confirmation mechanisms.

- License management

The license management service tracks and enforces license usage.

- Image management

The image management service handles the issues involved with accessing DICOM images.

- Reporting services

The reporting services are responsible for delivering and accepting study data, delivering report template data definitions, templates, etc., and managing the processes associated with completing and verifying reports.

- *syngo* Dynamics Portal service

This service enables access to *syngo* Dynamics via the Internet.

The communication between the network components is configurable via service tools.

Within the network, the following communication protocols are used:

- TCP/IP for communication and transport
- DICOM at application level

### Server/modality

The images from the modalities are transferred to the server and saved. How the incoming images are handled depends on the modality and on the server settings.

There are three typical cases:

1. DICOM images are transferred uncompressed to the server.

If the server's compression software is activated, images are compressed to lossless JPEG and stored; if not, images are stored uncompressed.

2. DICOM images are transferred compressed to the server.

Images are stored as they are without modifying the transfer syntax.

3. syngo Dynamics Portal is installed.

Incoming images from the modalities (compressed or uncompressed) are automatically transferred to the Web Encoder (as part of the syngo® Dynamics server or as a separate server) where images are transformed in non-DICOM files (static images are turned into .jpg and clips are turned into .wmv) and stored in a Web Cache.

## VMware vSphere or VMware Virtual Infrastructure

VMware's leading virtualization solutions provide multiple benefits to IT administrators and users. VMware virtualization creates a layer of abstraction between the resources required by an application and operating system, and the underlying hardware that provides those resources. A summary of the value of this abstraction layer includes the following:

- **Consolidation:** VMware technology allows multiple application servers to be consolidated onto one physical server, with little or no decrease in overall performance.
- **Ease of Provisioning:** VMware virtualization encapsulates an application into an image that can be duplicated or moved, greatly reducing the cost of application provisioning and deployment.
- **Manageability:** Virtual machines may be moved from server to server with no downtime using VMware® VMotion™, which simplifies common operations like hardware maintenance and reduces planned downtime.
- **Availability:** Unplanned downtime can be reduced and higher service levels can be provided to an application. VMware® High Availability (HA) ensures that in the case of an unplanned hardware failure, any affected virtual machines are restarted on another host in a VMware cluster.

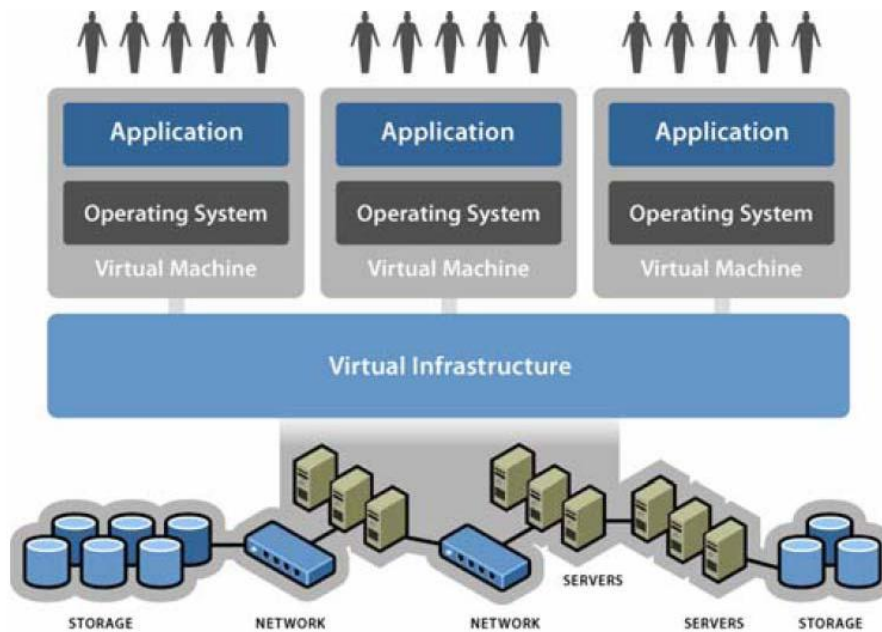
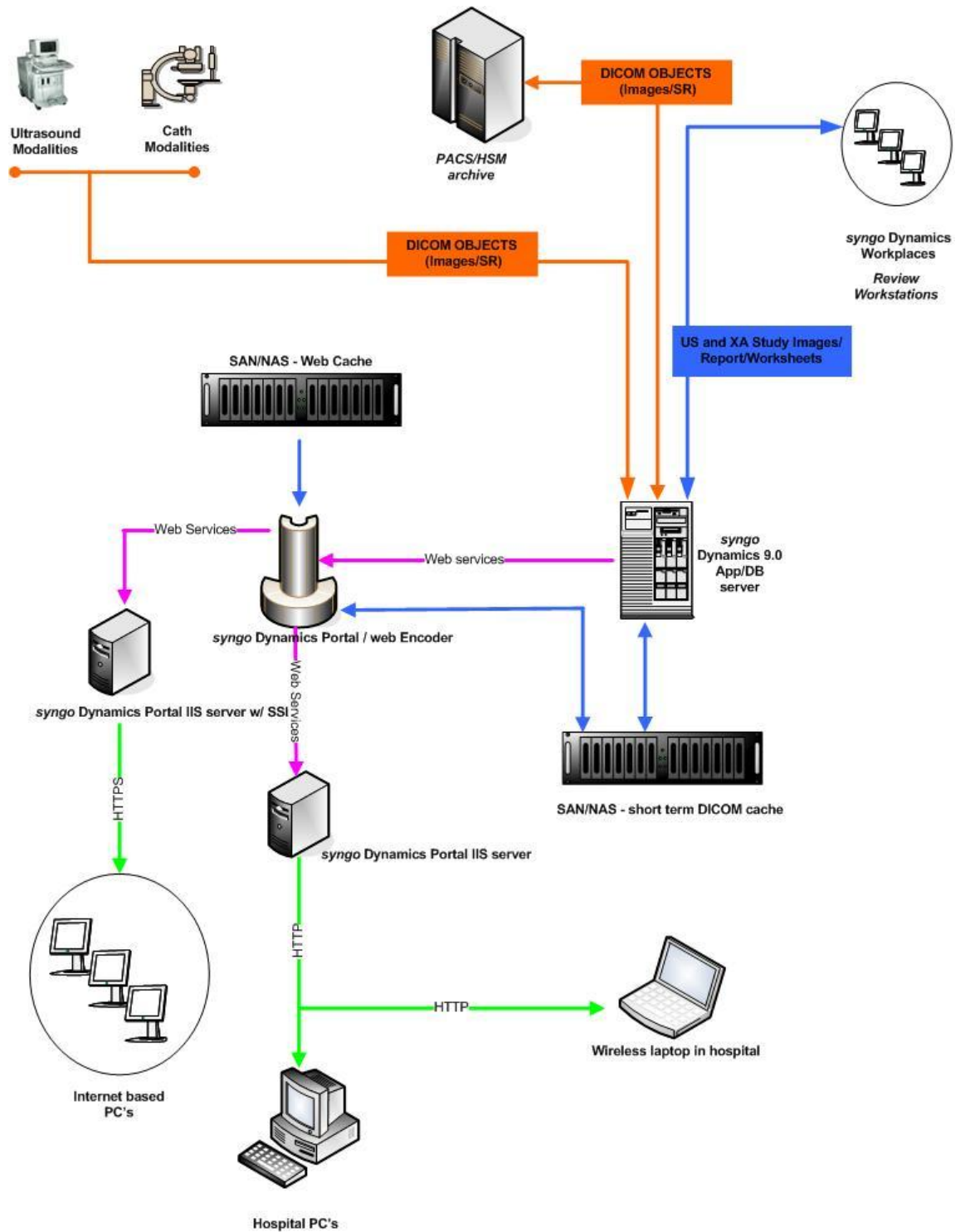


Figure 1. VMware vSphere Virtual Infrastructure

## Siemens *syngo*<sup>®</sup> Dynamics Architecture and Deployment Strategy

In this section, provide an overview of the application architecture, as well as how one typically deploys the application, in a physical environment, then virtual. Specifically provide information as to the various components of the product, and provide guidance as to how it is typically deployed. Provide schematics that show the various components (e.g. Web servers, apps servers, database), so that the number and rough sizes of physical components is clear.



## Testing Process and Results

To characterize the performance of Siemens *syngo*<sup>®</sup> Dynamics on VMware Infrastructure performance tests were carried out jointly by VMware and Siemens.

The HP workstation running the *syngo* Dynamics Application was used to measure the study load response time and the workload was added by increasing the number of running threads.

## Testing Methodology and Overview

The primary objectives of testing were to determine Siemens *syngo* Dynamics performance characteristics and show that Siemens *syngo* Dynamics can scale linearly and be run more resiliently on VMware virtual infrastructure. (We also wanted to ensure that customers could successfully deploy their mission-critical *syngo* Dynamics applications in the same virtual environments.) Testing also validated the operation of VMware features including vMotion, VMware DRS and VMware HA with *syngo* Dynamics deployments in a virtual environment.

## Hardware and Software Configuration

[Provide a description of the hardware tested, typically in table or spreadsheet form: Servers, Processors, Memory, Storage; installed software and operating systems

Ensure that CPU speeds, memory and core counts are specified for each server. Provide information on the storage that was used, including RAID levels, disk RPMs, and protocol (i.e. SAN or iSCSI).]

The following diagram provides details about the setup of ESX host servers and virtual machines used to perform the one-vCPU and two-vCPU tests described earlier.

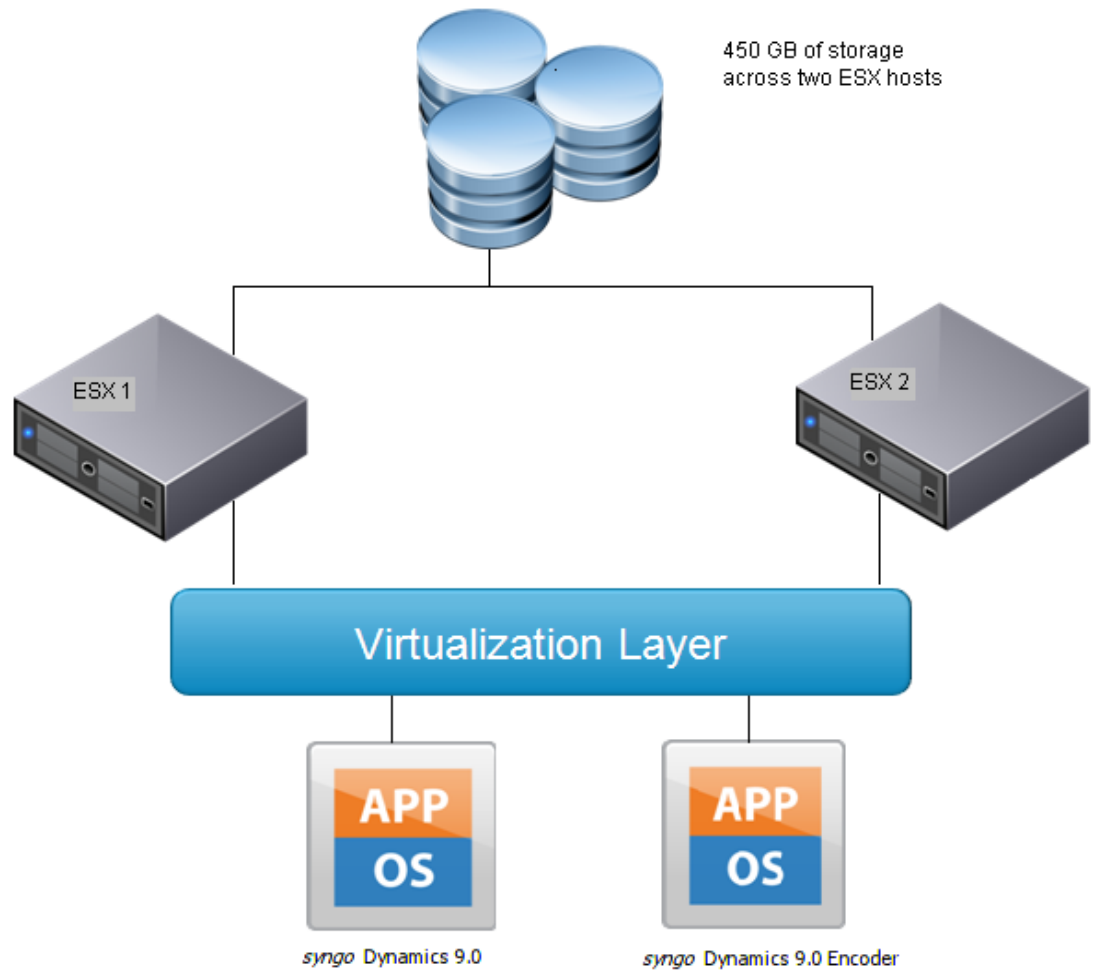


Figure 3. Hardware Configuration for *syngo* Dynamics ES2 Testing

## Hardware and System Host Configuration

The following table describes the configuration of ESX host servers and storage in the *syngo* Dynamics test configurations.

Table 1. ESX Host Hardware

HARDWARE	CONFIGURATION
Server	Two HP Proliant BL 460c G6 (Nehalem) servers. Each server is equipped with: <ul style="list-style-type: none"> <li>• 2.8 GHz dual quad-core Intel Xeon E5560</li> <li>• 48 GB RAM</li> </ul>
Storage	NetApp FAS 3020: <ul style="list-style-type: none"> <li>• Aggregate of 21 disks</li> <li>• RAID DP</li> <li>• 4 Gbps fiber connectivity</li> <li>• 10K RPM disks</li> <li>• FC protocol</li> </ul>

A Dual monitor workstation was used to measure performance of the system

HARDWARE	CONFIGURATION
Workstation	One HP xw4600 workstation equipped with: <ul style="list-style-type: none"> <li>• 3.0 GHz Intel core 2 Duo</li> <li>• 2 GB RAM</li> </ul>

## Installed Software

Table 1. Software Installed for Siemens Solution

Installed Software	
VMware	VMware vSphere 4.1, vCenter Server 4.1, ESXi@ 4.1
Microsoft	Microsoft Windows 2008R2 Standard, Microsoft SQL Server 2008 R1
Siemens Healthcare	Siemens <i>syngo</i> Dynamics 9.0

## Virtual Machine Configuration

The following table describes the configuration of virtual machines running on ESX host servers in the *syngo*<sup>®</sup> Dynamics test configurations.

Table 2. Virtual Machine Configuration

VIRTUAL MACHINE	HARDWARE CONFIGURATION	SOFTWARE INSTALLED
<i>syngo</i> Dynamics 9.0	<ul style="list-style-type: none"> <li>• 4 vCPUs</li> <li>• 8 GB memory</li> <li>• 1 vmxnet3 NIC adaptor</li> <li>• 1 USB adaptor (for attaching USB devices)</li> <li>• Minimum of 400 GB storage (OS 100GB, Database 100Gb, Thumbnail cache 100Gb, DICOM Cache 100Gb)</li> </ul>	Application / Database server
<i>syngo</i> Dynamics 9.0 Encoder	<ul style="list-style-type: none"> <li>• 8 vCPUs</li> <li>• 2 GB memory</li> <li>• 1 vmxnet3 NIC adaptor</li> <li>• 200 GB storage (OS 100Gb + web image cache 100Gb)</li> </ul>	IIS Web server / Image Encoder

## Workload Used

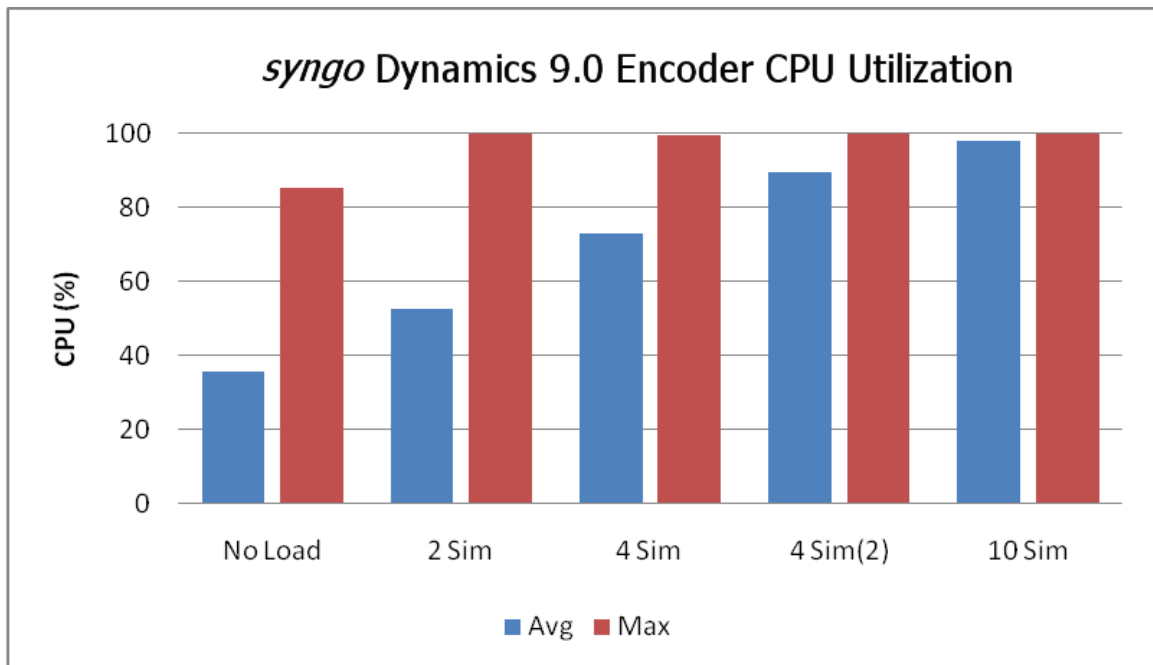
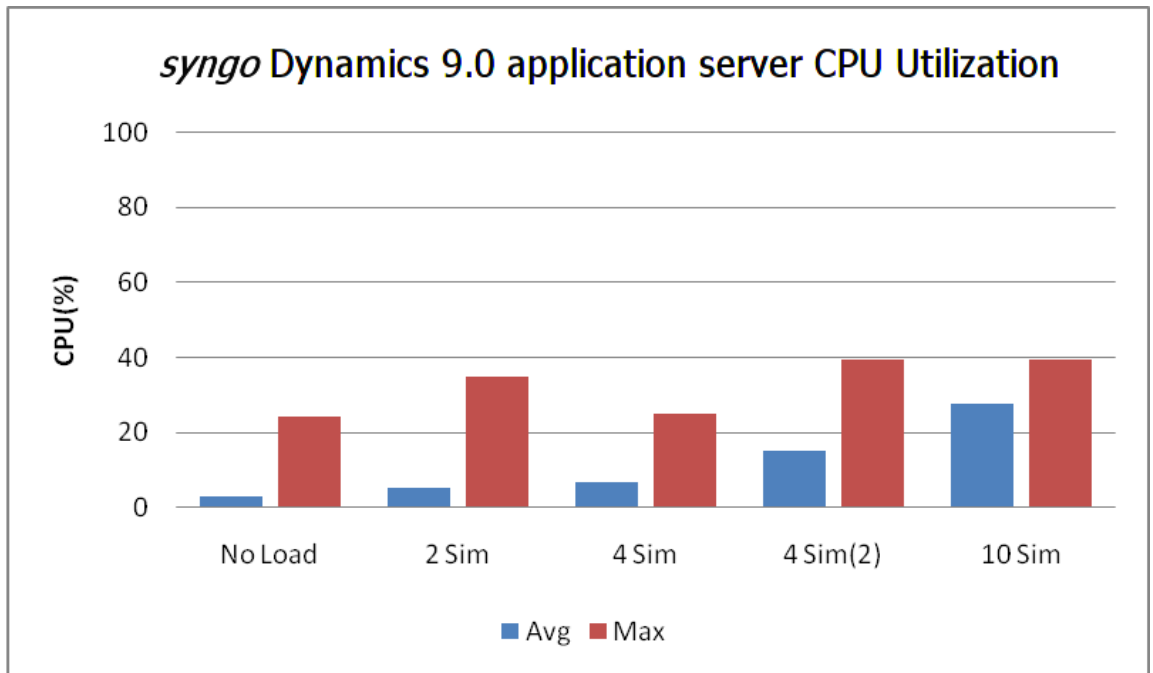
Work load on the server was simulated by sending DICOM images. These images were sent using Slim Sim DICOM simulator. We ran test under no load as well as test under low, medium and high.

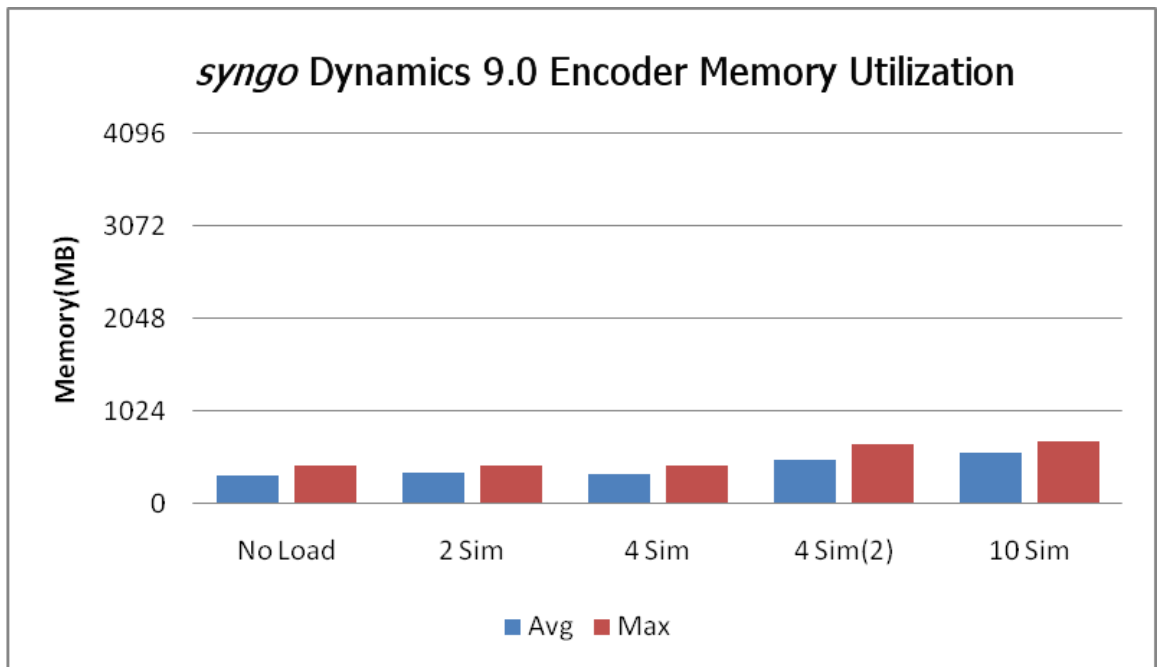
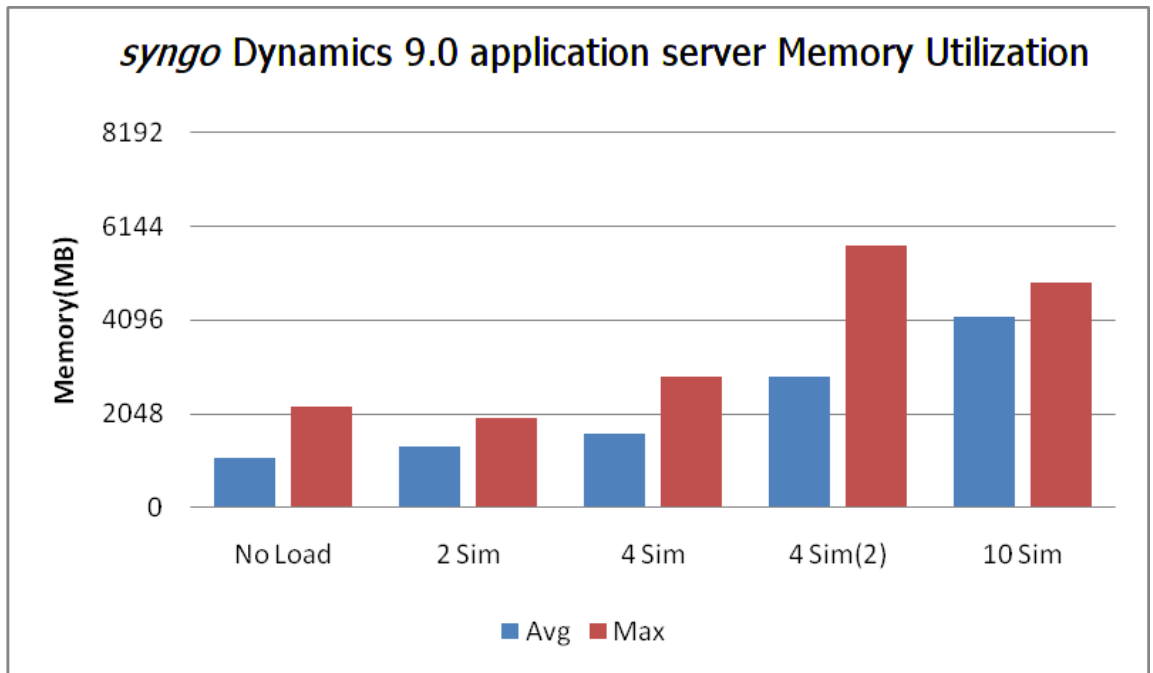
## Results Observed

The graphs below show Average and Max CPU utilizations, and memory consumptions for No Load, 2 Sim, 4 Sim, 4 Sim(2) and 10 Sim Tests.

The results show, especially in the *syngo* Dynamics 9.0 Encoder CPU utilization chart, a significantly high Average CPU utilization. This suggests two observations:

1. The virtual machine configuration used in the tests adequately handles load at the various user levels and transaction loads.
2. As seen in the 10 sim (high load) scenario it is possible to max out the CPU utilization. This situation will cause intermittent response time increase but can be alleviated through increasing the number of Logical CPUs allocated to the *syngo* Dynamics 9.0 Encoder VM. For planning purposes, administrators should leave adequate head-room for workload spikes





## Additional Testing

### High Availability

VMware HA delivers the availability needed by many applications running in virtual machines, independent of the operating system and application running in the virtual machine. VMware HA provides uniform, cost-effective failover protection against hardware and operating system failures within your virtualized IT

environment. VMware HA uses the following approach to provide increased business continuity for workloads running on the vSphere platform.

- Monitors virtual machines to detect operating system and hardware failures.
- Restarts virtual machines on other physical servers in the resource pool, without manual intervention, when server failure is detected.
- Protects applications from operating system failures by automatically restarting virtual machines when an operating system failure is detected.

### High Availability Test

To examine how Application Server and Encoder could leverage VMware HA, the test arranged Application Server and Encoder Server virtual machines on two hosts (ESX host-A and host-B respectively) in the node cluster. The physical host for ESX-A was then rebooted. VMware vSphere detected the interruption and automatically restarted the Application Server virtual machine on ESX host-B. The automatic restart completed in 130 seconds.

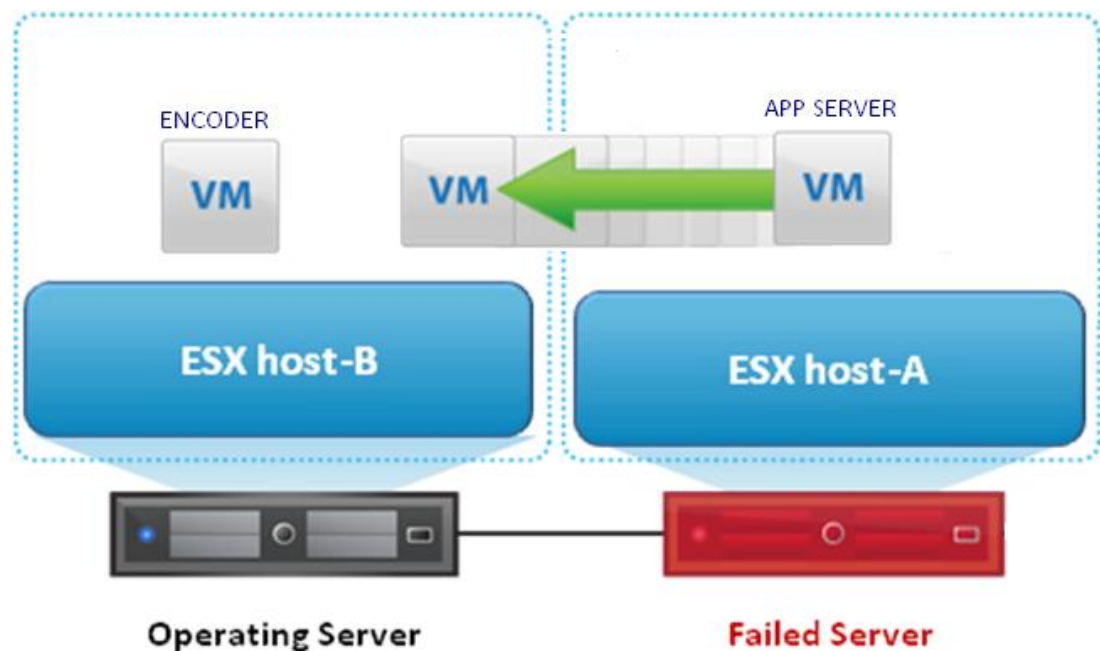


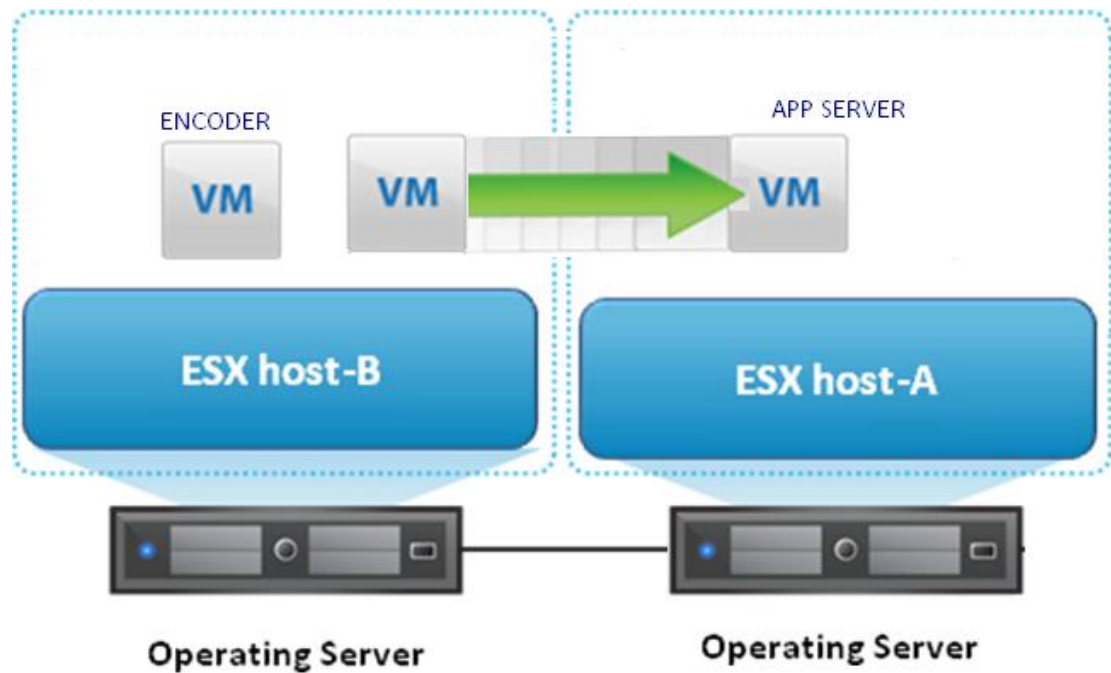
Figure 1. High Availability Test for Application Server and Encoder Server

### vMotion

vMotion enables the live migration of running virtual machines from one physical server to another, with zero downtime, continuous service availability, and complete transaction integrity. This capability makes hardware maintenance possible at any time of the day and does not require clustering or redundant servers. vMotion makes it possible to move online workloads as required, from one ESX host machine to another, in order to maintain service levels and performance. The scope of this test was to check the migration of the AppServer virtual machine.

### vMotion Test

With the Application Server and Encoder Server virtual machines running in same ESX hosts, the vMotion test initiated the migration the Application Server virtual machines to the ESX host-A.



### vMotion Observations for Application Server

vMotion migration was completed in 110 seconds, with no failures, indicating that user activity could continue successfully during any vMotion events. No negative impact on transaction execution time was observed.

## Deployment Best Practices

VMware recommends the following best practices derived from configuration and testing of the Siemens syngo® Dynamics application running on VMware virtual infrastructure.

- It is recommended that you use Intel-based Nehalem or AMD-based Shanghai processors which have the Hardware-Assist capabilities that help in performing memory management operations.
- While using Intel-based systems, ensure that the BIOS settings enable Hyperthreading, VT, and EPT options on all ESX hosts.
- Use Eager zeroed disks for better I/O performance. This can be done using the following VMware vmkfstools command:
 

```
vmkfstools -w abc.vmdk
```
- When configuring virtual machines, note that ESX has some overhead and allow for the CPU overhead required by virtualization. If the virtual machines are highly utilized (80 to 90 percent), leave one core on the host for the hypervisor's processing and don't allocate it to any virtual machine. If the virtual machines are lightly utilized (40 percent or less) you may over-commit in terms of vCPUs. In the case of the testing described in this document, the system was loaded with a large number of studies to see the performance under high cpu utilization (80 percent or greater), so one core was left uncommitted so it could be used for hypervisor processing.
- To decrease disk latency, it is recommended that you use Fiber Channel Adapters and configure proper RAID configuration with sufficient spindles.
- Install VMware tools on the virtual machines. The VMware Tools package provides support required for

shared folders and for drag and drop operations. Other tools in the package support synchronization of time in the guest operating system with time on the host, automatic grabbing and releasing of the mouse cursor, copy and paste operations between guest and host, and improved mouse performance in some guest operating systems.

- Consider using server-class network interface cards (NICs) for the best performance and configure paravirtualized vmxnet3 adapters for better network throughput.
- Ensure that the Service Console / VMkernel and virtual machines are configured on separate NICs.
- Disconnect or disable unused or unnecessary physical hardware devices, such as:
  - COM ports
  - LPT ports
  - USB controllers
  - Floppy drives
  - Optical drives (that is, CD or DVD drives)

Disconnecting or disabling these devices will help free up interrupt resources, because traditionally some devices such as USB controllers operate using a polling scheme that consumes extra CPU resources. Lastly, some PCI devices reserve blocks of memory, making that memory unavailable to ESX.

## Reference Architecture

[In this optional section, specify small, medium and large virtualized configurations, including the number and size of the virtual machines required for each configuration, and the approximate user counts or throughputs expected from each configuration.]

## Licensing

[In this optional section, provide information relevant to how to license the application when virtualized with VMware.]

## Technical Support

[In this section, provide instructions on how to access technical support for virtualized deployments of your application.]

## Conclusions

Overall, testing results show that running Siemens *syngo*<sup>®</sup> Dynamics on VMware Infrastructure performs well within expectations based on transaction load. Furthermore, it has potential to reduce cost, increase service levels and simplify the manageability of the application.

With respect to business continuity, Siemens *syngo* Dynamics leverages vMotion very well for “planned downtime” scenarios. Administrators can migrate live Encoder and Application Server virtual machines to allow for ESX host maintenance without impacting end-user uptime or performance.

[Add any additional conclusions from the effort in summary form.]

## Resources

Customers can find more information about VMware and Siemens *syngo*<sup>®</sup> Dynamics products via the links listed below:

Customers can find more information about VMware and Siemens products via the links listed below.

### **VMware Resources**

- VMware official website:  
<http://www.vmware.com/>
- VMware Infrastructure 3 and vSphere 4 product Web site:  
[http://www.vmware.com/products/data\\_center.html](http://www.vmware.com/products/data_center.html)
- VMware download Web site:  
<https://www.vmware.com/download/>
- VMware support Web site:  
<http://www.vmware.com/vmtn/>
- VMware Performance Tuning Paper:  
[http://www.vmware.com/pdf/vi\\_performance\\_tuning.pdf](http://www.vmware.com/pdf/vi_performance_tuning.pdf)
- System Compatibility Guide for a complete list of compatible hardware:  
[http://www.vmware.com/pdf/vi35\\_systems\\_guide.pdf](http://www.vmware.com/pdf/vi35_systems_guide.pdf)
- Storage/SAN Compatibility Guide for a complete list of compatible storage devices:  
[http://www.vmware.com/pdf/vi35\\_san\\_guide.pdf](http://www.vmware.com/pdf/vi35_san_guide.pdf)
- I/O Compatibility Guide for a complete list of compatible networking devices:  
[http://www.vmware.com/pdf/vi35\\_io\\_guide.pdf](http://www.vmware.com/pdf/vi35_io_guide.pdf)

### **Siemens Resources**

- Siemens Web site:  
[http://www.medical.siemens.com/webapp/wcs/stores/servlet/ProductDisplay~q\\_catalogId~e\\_-11~a\\_catTree~e\\_100010,1008631,1029622,1029617~a\\_langId~e\\_-11~a\\_productId~e\\_200797~a\\_storeId~e\\_10001.htm](http://www.medical.siemens.com/webapp/wcs/stores/servlet/ProductDisplay~q_catalogId~e_-11~a_catTree~e_100010,1008631,1029622,1029617~a_langId~e_-11~a_productId~e_200797~a_storeId~e_10001.htm)

## Appendix (Optional)

[In this optional section, provide full testing detail and documentation.]

