

DEPLOYING IN A VIRTUAL ENVIRONMENT:

SunGard's Ambit Reconciliation &
Exception Management Solution

TABLE OF CONTENTS

- I. Introduction
- II. SunGard-Intel-VMware-HP Partnership
- III. Corporate Profile – Large Financial Institution
- IV. SunGard Ambit intelliSUITE Overview
- V. VMware Infrastructure 3/Vmotion Overview
- VI. Advantages of Virtualizing Ambit intelliSUITE on VMware infrastructure
- VII. Validating Performance
- VIII. Summarizing Test Results
- IX. VMotion Test Results
- X. Sizing and Deployment Guidelines
- XI. Conclusions
- XII. Appendix A - Additional Performance Data

Note: This document references the Ambit intelliSUITE platform and all of the underlying products that the platform is comprised of, including intelliMATCH and intelliTRACS.

I. INTRODUCTION

For organizations looking to implement a matching and reconciliation with exceptions processing solution such as SunGard's Ambit intelliSUITE, there are a number of options to consider in determining the deployment methodology required to meet the needs of the business.

One deployment option is to increase the number of physical servers to scale to meet the user and transaction volume demands - otherwise, known as "server sprawl." While it can be reliable and is the traditional method for increasing space, this track can be inefficient – some physical servers do not fully maximize their processing capabilities, often running well below the percentage of CPU usage deemed efficient. The addition of more physical servers also means an increase in costs, and not simply the new hardware. Physical servers can consume massive amounts of energy and create tremendous heat, leading to skyrocketing energy bills. Disaster recovery is also a concern. With files stored on physical hardware, it can quickly become expensive to back up data and information in multiple locations.

One alternative deployment method is one of today's most powerful industry trends – virtualized environments. It provides the eco-friendly stance every company would like to take; avoiding the purchase of more physical hardware in favor of virtual environments is not only capable of saving money in a number of ways, but virtual environments have been proven to operate more efficiently as well, achieving increased utilization by running multiple workloads on the same server hardware. One of the lynchpins of virtualized environments is partitioning, defined by VMware as the ability to run multiple operating systems on a single physical system, fully isolated from each other but able to share the underlying hardware resources.

As these benefits become increasingly tangible for business owners and as company IT budgets get tighter, they become more resistant to traveling down the traditional path of purchasing more hardware. Recently a top financial services company delivered a series of SLAs (service level agreements) to SunGard and its virtual environment partners with the challenge to deliver the intelliSUITE solution operating in a virtual environment (such as VMware) with consistent peak performance. SunGard's working partners in this endeavor include VMware, Hewlett Packard (HP) and Intel.

The SunGard/VMware partnership is also being utilized to deliver SunGard Financial Systems' innovative Infinity initiative, which creates a new software development and on-demand delivery environment. Infinity enables financial institutions to discover, deploy and integrate SunGard components with their own proprietary or third party components. Infinity uses SunGard's Common Services Architecture (CSA); a service-oriented architecture (SOA) development framework offering business process management (BPM) and a virtualized, software-as-a-service (SaaS) infrastructure.

II. SUNGARD-INTEL-VMWARE-HP PARTNERSHIP

Utilizing a strategic partnership with HP and Intel, SunGard was able to deploy the intelliSUITE solution within the HP Partner Technology Access Center (PTAC) lab in Marlborough, Massachusetts. The PTAC provided access to state of the art HP servers that use Intel's Quad-Core Xeon® processors, chipsets, and Virtualization(VT) technology. Both HP and Intel software engineers worked closely with SunGard to resolve configuration, performance and other technical issues.

From HP's perspective, there are a number of benefits as a result of running intelliSUITE in a virtualized environment – including server consolidation, workload optimization and the ability to reclaim underutilized computing resources. Following the initial trial and testing of the intelliSUITE application in the VMware virtual environment, HP determined that companies need to consider not only the “virtualized environment,” but also the accompanying operational issues that go along with this environment. Issues that may include system management, failover, disaster recovery and backup are all beyond the scope of what an independent software vendor (ISV) might be able to “certify.” While an ISV may be able to certify that its software is capable of running in a virtualized environment, it is crucial that a client looking to implement a virtualized solution also insist that their hardware vendor test and document the entire end-to-end solution before deploying.

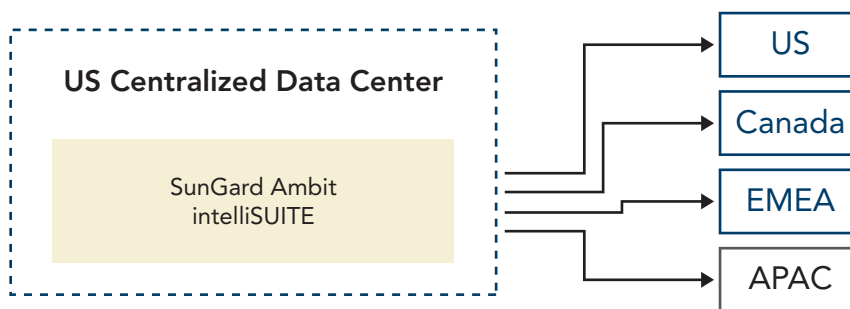
For this project, Intel was responsible for enabling the intelliSUITE application to run VMware's virtualization solution. Realizing the full value of virtualization requires servers that are built to handle the heavy demands of a virtualized and consolidated computing environment. Servers of just a few years ago were designed to host a single operating system. Successful virtualization with these systems requires software that can emulate a complete hardware environment for every guest operating system. This is a compute-intensive process that introduces significant performance overhead. It can slow application response times, limit scalability, and create complexity that can impact reliability and security.

Intel® Virtualization Technology (Intel® VT) addresses these challenges at the silicon level, by providing comprehensive hardware assists that boost virtualization software performance, improve application response times and provide greater reliability, security and flexibility. These integrated hardware assists accelerate fundamental virtualization processes throughout the platform to reduce latencies and avoid potential bottlenecks. They also reduce the demands placed on the virtualization software, so more processor cycles are available for running business applications. As a result, you can consolidate more applications and heavier workloads per server to get better value from your server and software investments. Intel works closely with VMware to help ensure that Intel's hardware-assisted virtualization technologies are broadly supported in today's and tomorrow's solutions, so they deliver high value while being completely transparent to IT organizations and end-users. The functionality of your virtualization solutions is unchanged. Your virtual servers are simply more responsive, more scalable and more reliable.

III. CORPORATE PROFILE – FORTUNE 500 FINANCIAL SERVICES COMPANY

A large Fortune 500 financial services company operating across more than 100 countries provided SunGard and its strategic partners with target SLAs. Its global network of users runs a 24x6 operation with minimal windows to allow for system maintenance, meaning uptime is of critical importance.

The requesting financial institution handles Nostro reconciliation for over 30 thousand accounts worldwide, requiring a scalable, robust system. The financial institution finds itself and its reconciliation operations challenged in a variety of ways, one of the most significant being total cost of ownership (TCO). Contributing to the TCO are costs associated with running physical hardware, including system maintenance and costs associated with processing infrastructure (servers). Other challenges are overall durability and finding a system scalable enough to meet the financial institution's needs and the ability to match the company's growth projections.



In addition to the financial institution's physical production environment, the Ambit intelliSUITE solution is also deployed within a disaster recovery (DR), user acceptance testing (UAT) and development environment. And as per the financial institution's policy, each environment should mirror that of production, in effect, leading to a large investment in servers and physical infrastructure.

The financial institution needed SunGard and its partners to address those challenges in addition to meeting specific performance targets while reducing total cost of ownership. The targeted performance SLAs within a virtual environment included supporting 1,500 users globally, with the ability to process up to 10 million transactions per day. A third workload target was the ability to handle 250 concurrent users. The financial institutions primary SLAs (Figure 1) and the load model for those 250 concurrent users (Figure 2) are shown below:

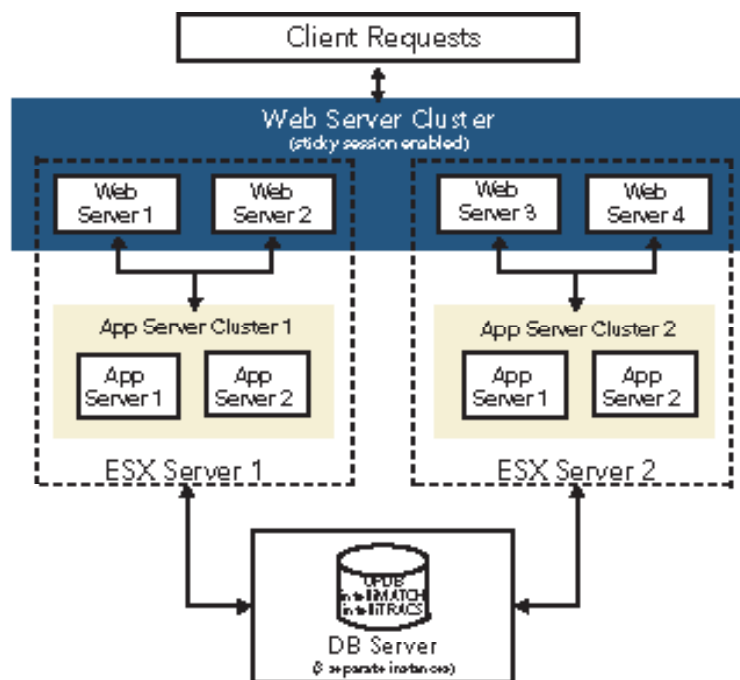
Item	Configuration settings
Total number of Users	250
Ramp up pattern / duration	5 Users / 1 minute
Ramp down pattern / duration	5 Users / 1 minute
Steady load duration	50 Users – 30 minutes 100 Users – 30 minutes 150 Users – 30 minutes 200 users – 20 minutes 250 users – 30 minutes
Network Speed	Maximum bandwidth

S.No	Business Process	No of Users	Think time (seconds)	Pacing time (seconds)
1	Dashboard	8	5	10 – 20
2	Case Edit	21	5	10 – 20
3	Quick Find	23	5	10 – 20
4	Manual match and unmatch	198	2	10 – 20
	Total	250		

The following diagram depicts the Ambit IntelliSuite solution as deployed in virtual environment running on Windows Server 2008 and VMWare® Infrastructure 3 with VMWare® VMotion.

All IntelliSuite presentation and application tier components were configured to run on two VMWare® ESX host servers. The data tier was configured to run on a separate physical server, running multiple Microsoft SQL Server instances and databases. The presentation, application and data tier servers all ran on Intel's Quad-Core Xeon® processors and Virtualization technologies.

Note that the virtual web servers are configured as a clustered set with load balancing across the two ESX servers with sticky session enabled. The virtual application servers maintain affinity with the ESX server on which they are deployed. This configuration provides an optimal level of performance by limiting the amount of I/O between the application tiers within each ESX server.



IV. SUNGARD AMBIT INTELLISUITE OVERVIEW

SunGard's Ambit intelliSUITE is comprised of real-time transaction management solutions that, taken together, provide automation throughout the transaction lifecycle. intelliSUITE solutions offer a modular approach to transaction management, enabling our customers to automate the processes they require when they require.

intelliSUITE solutions are highly scalable and highly flexible, capable of integrating with existing legacy systems and can manage transactions across an enterprise. Many top tier clients of intelliSUITE manage high volumes of transactions across their lines of business.

- Implement quickly with pre-packaged modules and workflows
- Run efficiently with the ease of adding new reconciliations
- Manage effectively through an integrated and actionable dashboard
- Maintain at low cost on a single, enterprise-wide platform

V. VMWARE INFRASTRUCTURE 3/ AND VMWARE VMOTION OVERVIEW

The underlying platform for building a dynamic, self-optimizing data center is built on VMware Infrastructure 3. VMware Infrastructure 3 abstracts processor, memory, storage and networking resources into multiple virtual machines, providing greater hardware utilization and flexibility. Production-proven at thousands of customers of all sizes, VMware ESX, the hypervisor within VMware Infrastructure, delivers enterprise-class performance, scalability, and flexibility.

VMware Infrastructure 3 simplifies IT so companies leverage their storage, network, and computing resources to control costs and respond faster. The VMware Infrastructure 3 approach to IT management creates virtual services out of the physical IT infrastructure, enabling administrators to allocate these virtual resources quickly to the business units that need them the most. Hardware management can be separated from software management, and hardware equipment can be treated as a single pool of processing, storage and networking power to be allocated and de-allocated in real time to various software services. In a virtual infrastructure, users see resources as if they were dedicated to them while the administrator can manage and optimize resources across the enterprise.

Virtualization is a first step towards a responsive data center that makes efficient use of resources and responds rapidly to changing business needs. Virtualized IT data centers can provide a sustainable competitive advantage by reducing costs, improving operational efficiencies and increasing application availability. For more information on VMware Infrastructure, please visit www.vmware.com.

VI. ADVANTAGES OF VIRTUALIZING AMBIT INTELLISUITE ON VMWARE INFRASTRUCTURE

Significant benefits were derived out of the intelliSUITE, VMware, HP and Intel virtual environment testing. The most obvious of all of these benefits has already been mentioned – cost savings and reduction through server consolidation.

To compare cost savings, we will take a look at the production servers in both the native and virtual environments. In the native environment, the financial institution maintained the 2x2x1 server setup previously mentioned (two Web, two Application and one Database) with an additional two servers running software for automated agent processing – leading to seven physical servers to maintain, keep cool and staff. Virtualization provides the ability to consolidate those servers into a mere two servers (host machines) in total.

With similar numbers of servers across three other environments (development, UAT and DR) the total number of physical servers required to support the intelliSUITE solution becomes very large.

As the graphs and following section demonstrate, there are substantial increases in hardware and software performance when scaling up virtual machines. Tied directly into the virtual environment is VMware VMotion, which can allow clients similar to our large financial institution to avoid planned downtime and reduce cost associated with patches, upgrades and other maintenance tasks.

Other benefits include:

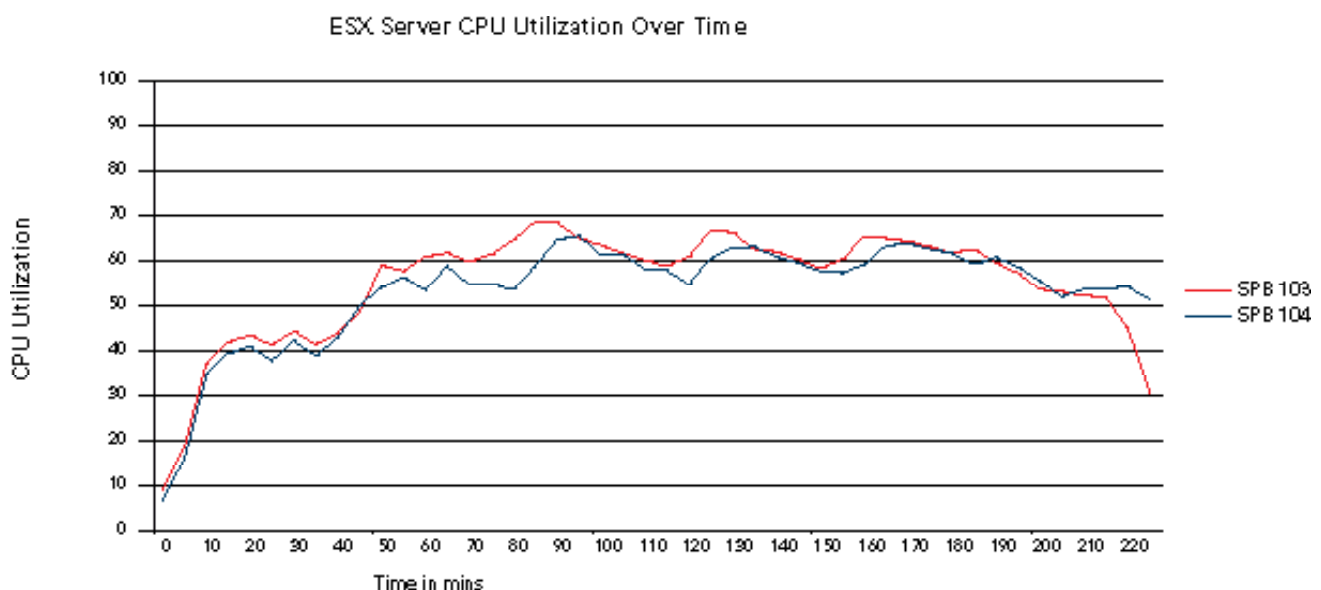
- Rapid provisioning with templates
- High Availability with VMware® High Availability (HA) and VMware® Distributed Resource Scheduling (DRS)

VII. VALIDATING PERFORMANCE

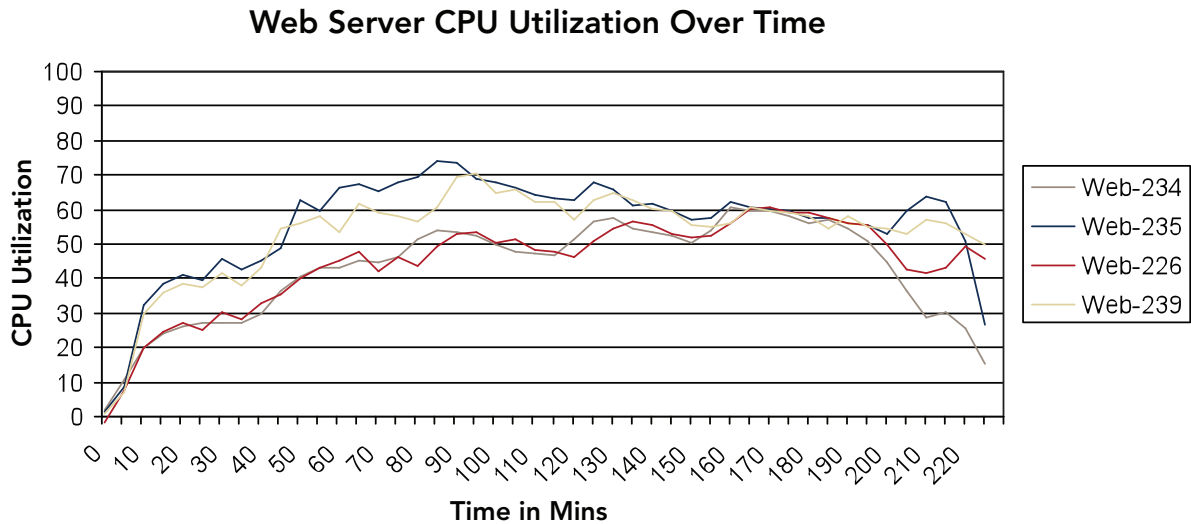
Following the framework and both physical and virtual testing environments developed by Intel and HP, it has been determined that running intelliSUITE on two ESX blade servers hosting multiple virtual environments (four application server images and four Web server images) allowed for increased scalability and other benefits. The table below details the hardware resources used for the testing.

ESX Server 1	HP Proliant BL460c G1 Intel Xeon x5460 @ 3.16 Ghz (2 Quadcore - 8 CPU) 32 GB RAM
ESX Server 2	HP Proliant BL460c G1 Intel Xeon x5460 @ 3.16 Ghz (2 Quadcore - 8 CPU) 32 GB RAM
VM Web Server Images	Total no of images - 4 VCPU - 2 Memory - 2 GB SCSI Controller - LSI Logic VM Network - Enhanced Vmxnet (network shared with host)
VM App Server Images	Total no of images - 4 VCPU - 2 Memory - 2 GB SCSI Controller - LSI Logic VM Network - Enhanced Vmxnet (network shared with host)
Database Server	2 - Intel Xeon Quad Core - 3.16 Ghz 32 GB Ram 140 GB HDD
Load Runner Generator	Intel Xeon Dual Core - 3.60 Ghz 4 GB Ram 70 GB HDD
Network Speed	1 Gbps (for ESX servers)
Storage	300 GB SAN connected through Fibre channel

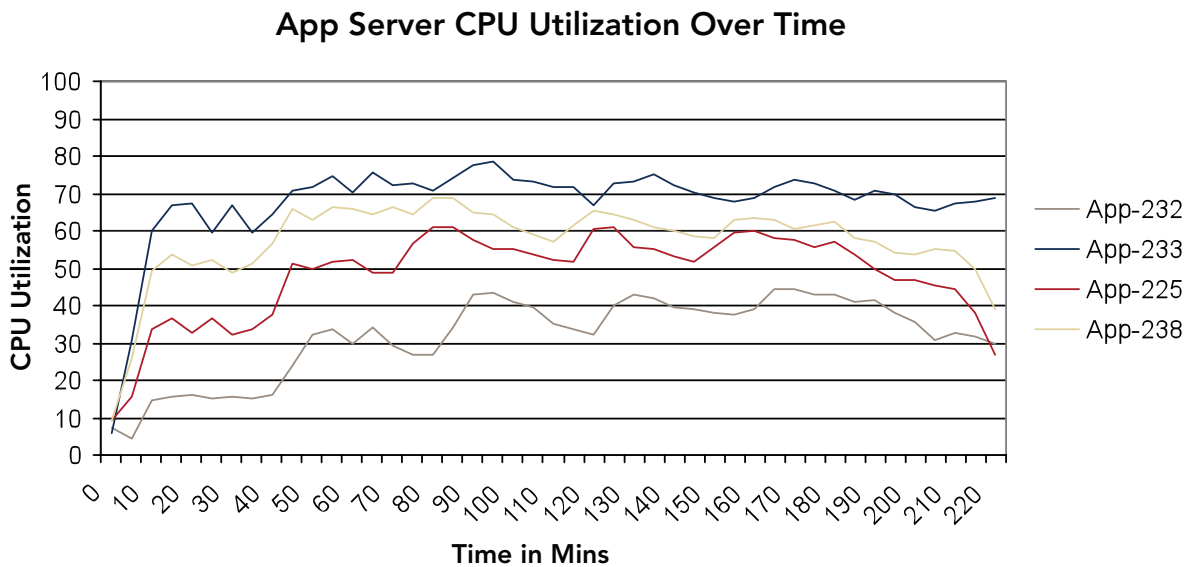
The line graph below illustrates the average CPU utilization of both ESX servers where the Web and application servers were hosted.



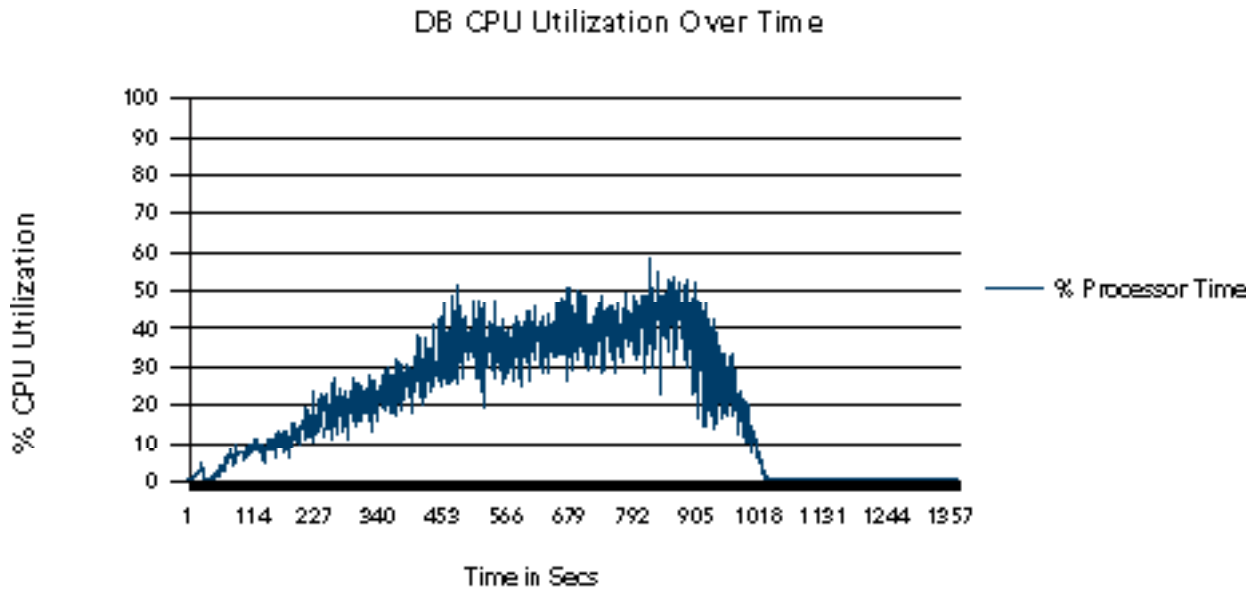
As indicated in the graph, the gradual increase of CPU utilization coincides with respect to the increases in user load. CPU utilization stabilizes around 150 users, while CPU utilization averages out to around 60%. Similarly, the average processor utilization for the Web servers between 150-250 users was also 60%.



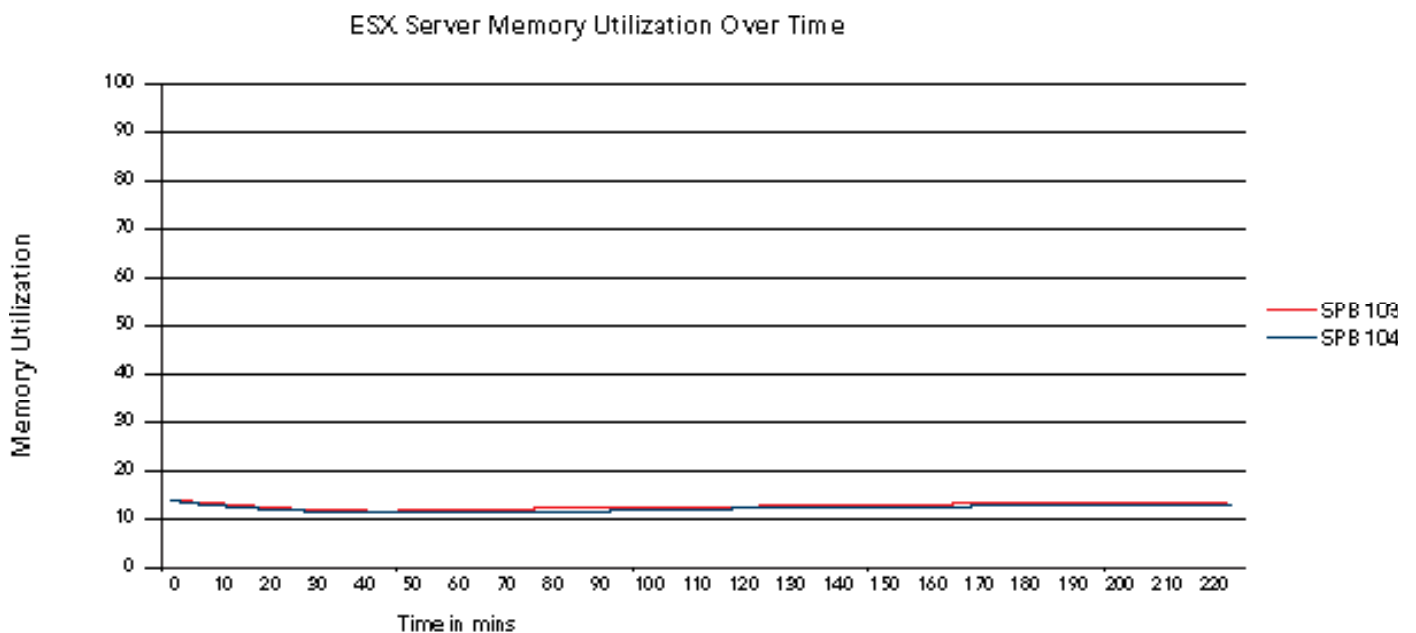
User loads of 150-250 on the application server utilize a slightly lower percentage CPU.



The database was affected similarly under the user load requirements. Processor utilization of the database rose concurrently with the user load. However, the average processor utilization for 250 users was 41%.

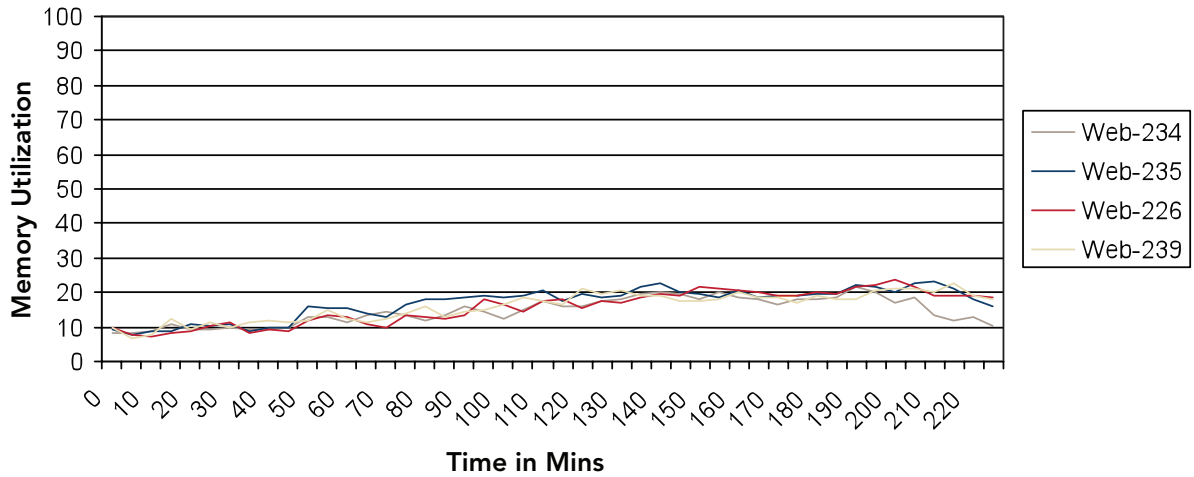


Another key performance metric of implementing and optimizing intelliSUITE in VMware infrastructure is memory utilization across the various servers. The amount of memory utilized by the ESX servers was hovered in the range of 12% of the total available 32 GB.

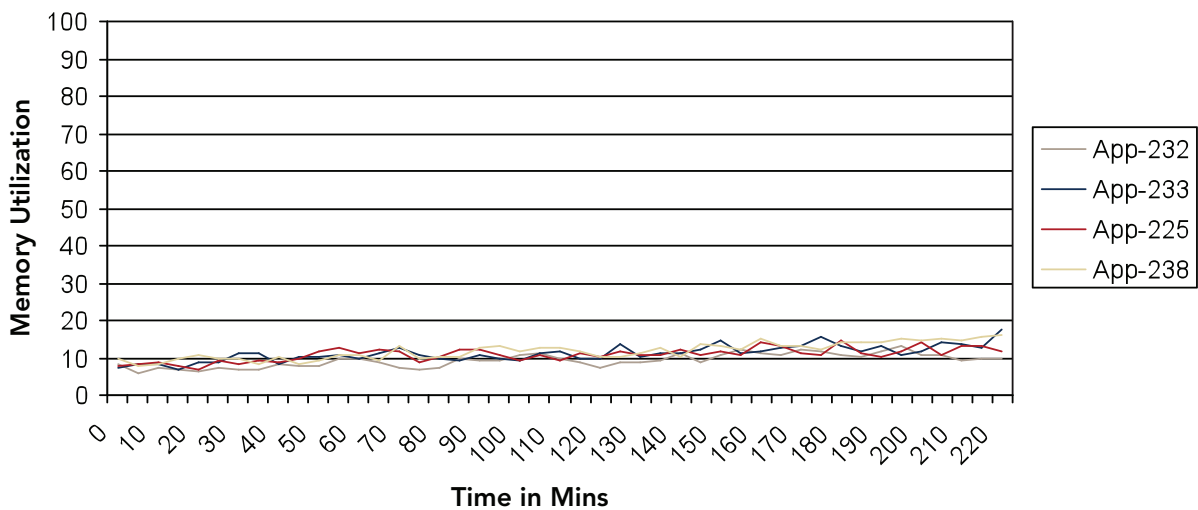


The average memory utilization of both Web servers and the Application servers stays true to the trend and gradually increases over time as the user load increases, consuming roughly 20% of that available to each Web server and about 15% in each Application server.

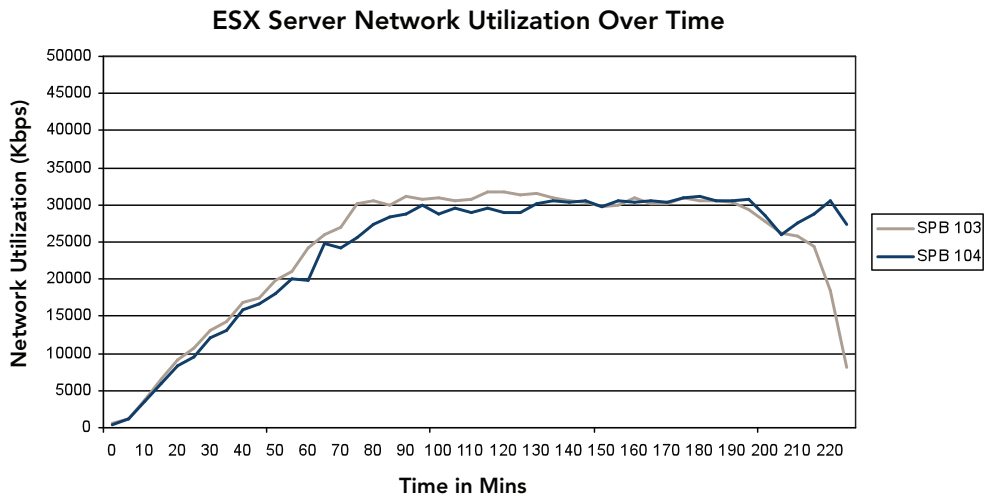
Web Server Memory Utilization Over Time



App Server Memory Utilization Over Time



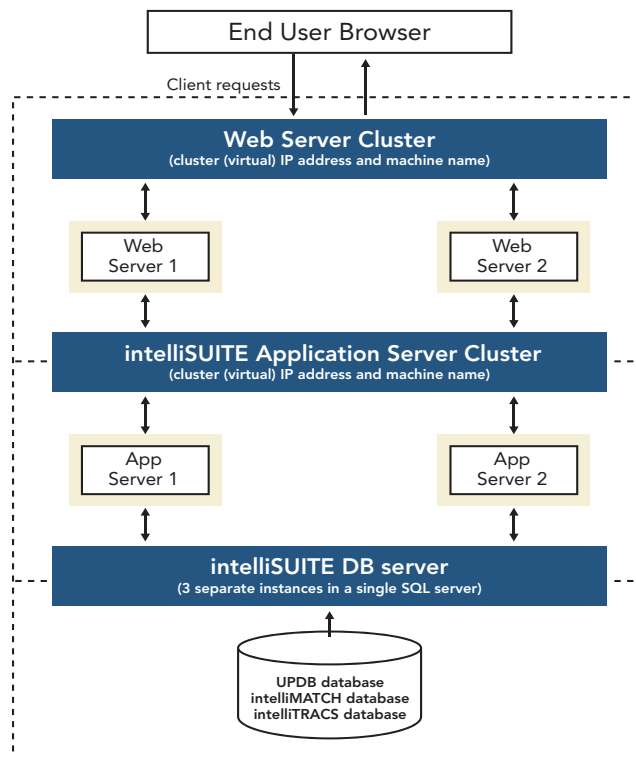
Finally, network utilization is another key performance indicator measured during the testing. The graph below illustrates the average network utilization (in MB) of both of the ESX servers under various user loads. Out of the maximum bandwidth of 1Gbps, ESX servers utilized an average of 31110 KBps of data (sent/received) per second during the trial testing of user loads between 150-250.



During the testing, opportunities arose to determine solutions for locating peak operating conditions. Later refined and detailed, those opportunities have been developed into a set of guidelines for operating intelliSUITE in the VMware virtual environment.

VIII. SUMMARIZING TEST RESULTS

The summary tables below illustrate the differences in the results between the physical hardware and virtual environment performances. The initial figure shows the setup of the physical hardware environment.



Average response times in the physical deployment infrastructure.

Transaction Name	50 users	100 users	150 users	200 users	250 users
Quick Find					
S01_T02_STeP_QuickFind_Search_Input	0.395	1.755	4.3	8.397	10.856
S01_T03_STeP_QuickFind_Search_JAPA_Amount	0.457	1.048	3.13	6.338	9.555
S01_T03_STeP_QuickFind_Search_LAC_Amount	0.782	1.672	3.412	6.627	9.996
S01_T03_STeP_QuickFind_Search_LAC_Currency	0.49	1.433	3.021	6.194	9.161
S01_T03_STeP_QuickFind_Search_LAC_Date	0.542	1.363	3.47	6.129	9.631
Manual Match & Unmatch					
S02_1_T02_STeP_QuickFind_Unmatch_Search_STEP1	1.243	2.214	4.88	8.83	12.404
S02_1_T03_STeP_QuickFind_UnMatchTxnID_Selection_STEP1	0.494	1.518	4.783	8.876	12.758
S02_1_T04_STeP_QuickFind_MatchGroupCreation_STEP1	1.017	4.037	7.74	12.158	15.377
S02_1_T05_STeP_QuickFind_Match_Search_STEP1	3.116	5.76	13.709	21.358	29.867
S02_1_T06_STeP_QuickFind_MatchedID_Selection_STEP1	0.965	2.535	7.782	14.205	21.953
S02_1_T07_STeP_QuickFind_MatchGroup_Dissolve_STEP1	0.521	4.147	9.661	14.285	16.526
S02_1_T08_STeP_QuickFind_Unmatch_ConfirmSearch_STEP1	1.738	3.981	10.296	17.713	24.736
S02_STeP_HomeLink_Selection	0.879	2.54	7.101	14.31	22.034
S02_STeP_QuickFind_Search_Input	0.476	2.167	6.159	10.098	13.436
Case Edit					
S03_1_T02_STeP_SearchCase_LAC	0.908	2.022	4.207	8.377	10.949
S03_1_T03_STeP_SearchedResults_CaseSelected_LAC	0.283	0.829	1.945	3.673	5.398
S03_1_T04_STeP_CaseEdit_EditLinkSelection_LAC	0.974	1.997	4.624	8.083	12.202
S03_1_T05_STeP_CaseEdit_Fields_Update_LAC	1.389	2.768	5.796	10.407	16.48
S03_STeP_HomeLink_Selection	0.702	1.984	4.924	10.611	15.347
Dashboard					
S07_T01_STeP_Dashboard_LinkSelection	0.317	1.122	2.21	4.089	4.983
S07_T02_STeP_Dashboard_PanelCreation	0.061	0.385	0.847	1.585	2.259
S07_T03_STeP_Dashboard_KPISelection	0.226	0.771	1.466	2.726	4.435
S07_T04_STeP_Dashboard_Display_SelectedKPI	0.35	1.406	3.362	6.392	9.651
S07_T05_STeP_Dashboard_PanelDeletion	0.141	0.766	2.036	4.13	5.777

You will notice there is a performance gain when the intelliSUITE topology is deployed on the virtual host versus a physical server. This is attributed to the fact that all I/O execution between the presentation and application tier virtual instances are performed within the memory space of the virtual host server. The Intel and VMware architecture provides for optimal virtual I/O which in turn reduces the need for the I/O execution to occur within the physical adapters.

Average response time in the virtual deployment infrastructure.

Transaction Name	50 users	100 users	150 users	200 users	250 users
	Avg	Avg	Avg	Avg	Avg
Quick Find					
S01_T02_STeP_QuickFind_Search_Input	0.634	1.861	4.021	8.032	12.59
S01_T03_STeP_QuickFind_Search_JAPA_Amount	0.706	1.331	2.574	4.182	6.286
S01_T03_STeP_QuickFind_Search_LAC_Amount	1.13	1.687	3.08	4.981	6.829
S01_T03_STeP_QuickFind_Search_LAC_Currency	0.708	1.35	2.534	4.39	6.32
S01_T03_STeP_QuickFind_Search_LAC_Date	0.748	1.441	2.741	4.393	6.375
Manual Match & Unmatch					
S02_1_T02_STeP_QuickFind_Unmatch_Search_STEP1	1.67	2.67	4.50	7.21	9.63
S02_1_T03_STeP_QuickFind_UnMatchTxnID_Selection_STEP1	0.787	1.875	4.314	8.125	11.723
S02_1_T04_STeP_QuickFind_MatchGroupCreation_STEP1	2.128	4.782	7.002	8.178	10.824
S02_1_T05_STeP_QuickFind_Match_Search_STEP1	3.679	6.549	12.972	21.933	30.903
S02_1_T06_STeP_QuickFind_MatchedID_Selection_STEP1	1.447	3.26	6.985	12.79	18.199
S02_1_T07_STeP_QuickFind_MatchGroup_Dissolve_STEP1	1.383	5.282	7.822	10.7	15.47
S02_1_T08_STeP_QuickFind_Unmatch_ConfirmSearch_STEP1	2.399	5.007	10.13	18.288	26.399
S02_STeP_HomeLink_Selection	1.312	3.238	6.826	15.151	22.363
S02_STeP_QuickFind_Search_Input	0.747	2.268	5.897	11.495	16.972
Case Edit					
S03_1_T02_STeP_SearchCase_LAC	1.194	2.077	3.419	5.164	7.145
S03_1_T03_STeP_SearchedResults_CaseSelected_LAC	0.39	0.87	1.71	3.43	5.30
S03_1_T04_STeP_CaseEdit_EditLinkSelection_LAC	1.264	2.113	3.187	5.03	7.166
S03_1_T05_STeP_CaseEdit_Fields_Update_LAC	1.814	2.908	4.385	7.127	10.19
S03_STeP_HomeLink_Selection	0.991	2.365	5.269	11.248	17.724
Dashboard					
S07_T01_STeP_Dashboard_LinkSelection	0.491	1.201	2.147	3.732	5.569
S07_T02_STeP_Dashboard_PanelCreation	0.132	0.437	0.882	1.653	2.586
S07_T03_STeP_Dashboard_KPISelection	0.32	0.79	1.17	2.02	2.93
S07_T04_STeP_Dashboard_Display_SelectedKPI	0.629	1.833	3.564	7.962	11.822
S07_T05_STeP_Dashboard_PanelDeletion	0.249	1.518	2.019	4.568	7.016

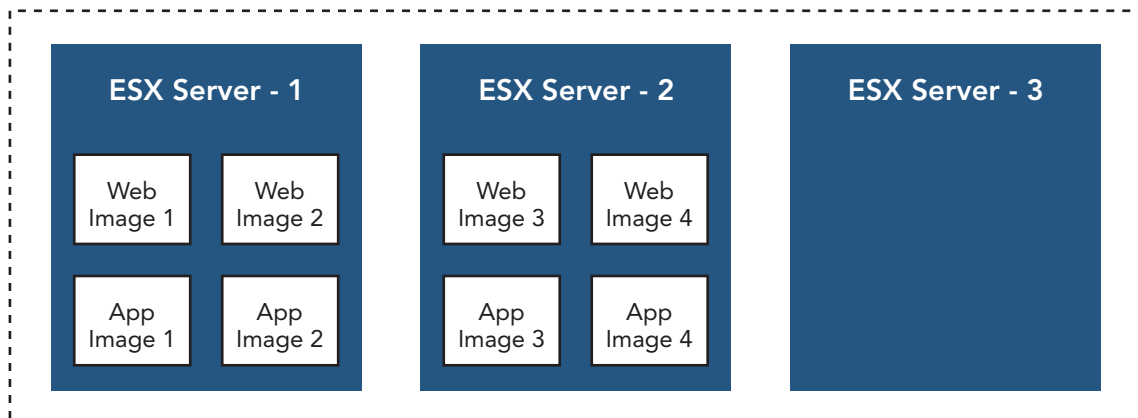
IX. VMOTION TEST RESULTS

This testing was conducted to observe the performance of intelliSUITE during the migration of virtual machines via VMware VMotion, from one host to another while subjected to a real-time load.

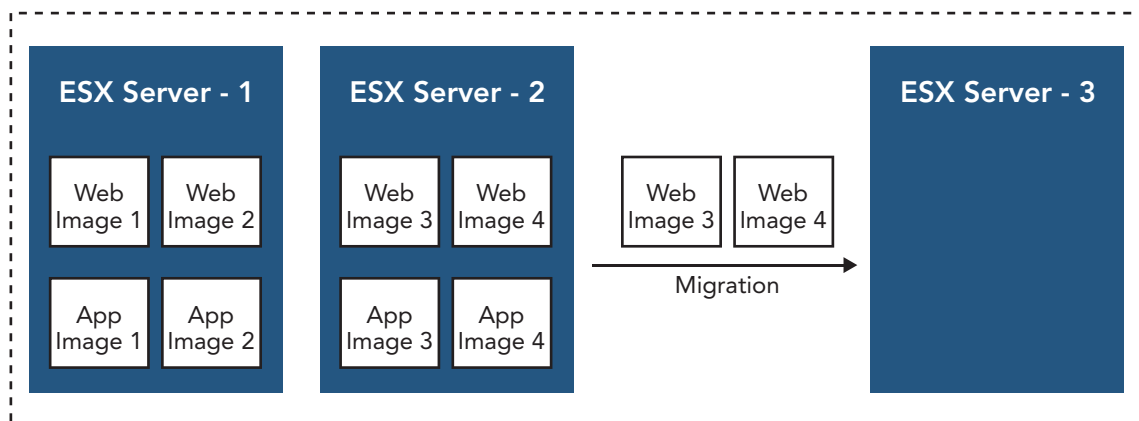
Test scripts were created and executed using LoadRunner 9.0 with the following transaction load profile.

S.No	Business Process	No of Users	Think time	Pacing time
1	Dashboard	8	0 Secs	10 – 20 Secs
2	Case Edit	21	0 Secs	10 – 20 Secs
3	Quick Find	23	0 Secs	10 – 20 Secs
4	Manual match & Unmatch	198	0 Secs	10 – 20 Secs
	Total	250		

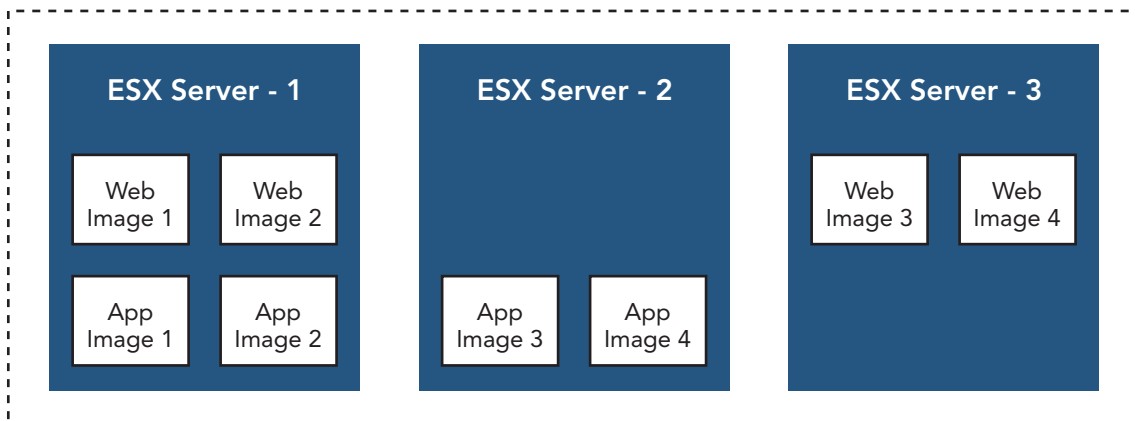
During execution of the load the web server virtual machines were manually migrated from one host to the other as demonstrated in the three stages in the following diagram:



Stage 1: The tests are running with eight images in two ESX servers.



Stage 2: The tests are running and migration is started from ESX server 2 to server 3 for the Web images 3 and 4.



Stage 3: The migration is completed and the tests are still running with Web images 3 & 4 in ESX server 3 and the other images in same hosts.

The VMotion test results can be summarized using the migration period and response time. The total time to migrate two virtual machines from one host to another was two seconds and the number of users running during the migration was 250. Migration occurred within two seconds. T denotes the time at which migration was started. The following table shows the response time for the transactions for the duration $T-10$ to $T+10$. No transactions failures or user disconnections were observed during the migration of virtual machines.

Transaction Name	Avg. Resp Time	90 Percentile Resp Time
Quick Find		
S01_T02_STeP_QuickFind_Search_Input	11.472	17.073
S01_T03_STeP_QuickFind_Search_JAPA_Amount	2.547	2.547
S01_T03_STeP_QuickFind_Search_LAC_Amount	6.81	9.144
S01_T03_STeP_QuickFind_Search_LAC_Currency	6.566	8.578
S01_T03_STeP_QuickFind_Search_LAC_Date	6.618	9.972
Manual Match & Unmatch		
S02_1_T02_STeP_QuickFind_Unmatch_Search_STEP1	7.493	12.719
S02_1_T03_STeP_QuickFind_UnMatchTxnID_Selection_STEP1	7.843	13.446
S02_1_T04_STeP_QuickFind_MatchGroupCreation_STEP1	11.484	15.465
S02_1_T05_STeP_QuickFind_Match_Search_STEP1	19.684	22.764
S02_1_T06_STeP_QuickFind_MatchedID_Selection_STEP1	14.238	17.8
S02_1_T07_STeP_QuickFind_MatchGroup_Dissolve_STEP1	11.744	19.734
S02_1_T08_STeP_QuickFind_Unmatch_ConfirmSearch_STEP1	16.164	17.891
S02_STeP_HomeLink_Selection	19.426	22.641
S02_STeP_QuickFind_Search_Input	12.919	17.742
Case Edit		
S03_1_T02_STeP_SearchCase_LAC	6.1	9.91
S03_1_T03_STeP_SearchedResults_CaseSelected_LAC	3.137	4.448
S03_1_T04_STeP_CaseEdit_EditLinkSelection_LAC	11.163	13.578
S03_1_T05_STeP_CaseEdit_Fields_Update_LAC	8.979	9.335
S03_STeP_HomeLink_Selection	14.554	21.789
Dashboard		
S07_T01_STeP_Dashboard_LinkSelection	5.089	6.845
S07_T02_STeP_Dashboard_PanelCreation	1.831	2.227
S07_T03_STeP_Dashboard_KPISelection	1.881	2.066
S07_T04_STeP_Dashboard_Display_SelectedKPI	7.423	7.539
S07_T05_STeP_Dashboard_PanelDeletion	7.196	12.015

X. SIZING AND DEPLOYMENT GUIDELINES

This section provides performance related guidelines and recommended configurations for running intelliSUITE in VMware virtualized environments. The first and most important recommendation is to disable any unnecessary windows services. Left unused and unattended, these services will drain resources. For the same reason, it is also crucial to disable unnecessary serial ports, CD-ROM drives and other device drivers as they are not needed to run the application efficiently and effectively. Looking at best practices specifically tailored to the VMware environment, it has been determined that to run the application efficiently it is wise to alter your network adapter to "Enhanced VMXNet," and to optimize the hosts for the VM network.

- Enter System BIOS and enable Intel Virtualization Technology.
 - Disable unnecessary windows services
 - Change the bus logic to LSI logic
-
- o Login to the VI Client
 - o Shut down the guest
 - o Locate the guest machine in the VMware® Infrastructure (VI) Client
 - o Click on 'Edit settings' select in the 'Summary' tab
 - o Change the SCSI Controller logic to 'LSI Logic'
-
- Disable unnecessary serial ports, CDROM and other device drivers
-
- o Login to the VI Client
 - o Shut down the guest
 - o Locate the guest machine in the VI client
 - o Click on 'Edit settings' select in the 'Summary' tab
 - o To disable the unnecessary devices, either uncheck the 'Connected' & 'Connect on Power on' checkboxes or remove the device by selecting it and clicking on 'Remove'
-
- Configure the hosts for VM network with transmit coalesce
-
- o Login to the VI Client
 - o Select a host and make sure that all the guests running in that host are shutdown
 - o Select the 'Configuration' tab
 - o Click on 'Advanced Settings' in the 'Software' menu
 - o Click the 'Net' tab
 - o Edit the value of Net.vmxnetThroughputWeight, changing it from the default of 0 to 128, then click 'OK'
 - o Reboot the selected host.
 - o Refer to 'System Tuning' section in the following link 'http://www.vmware.com/files/pdf/consolidating_webapps_vi3_wp.pdf' for more details.

- Change the Network adapter to 'Enhanced VMXNet'
 - o During the process of creating the virtual image, make sure that you select 'Enhanced VMXNet' as network adapter. If not, please follow the steps below.
 - o Capture the existing IP address details of the guest OS as we will be deleting it and recreating them.
 - o Login to the VI Client
 - o Select a guest and make sure that it is shut down
 - o Select the 'Edit settings' link available in the 'Summary' tab.
 - o Click on 'Add' and select 'Ethernet Adapter'
 - o Make sure that you select 'Enhanced VMXnet' as Adapter.
 - o Select 'Connect at Power on' checkbox.
 - o Click 'Next' and complete the wizard.
 - o Go back to the 'Edit settings' link and delete the old Ethernet adapter.
 - o Start the guest OS and login through the VI Console.
 - o Reassign the old IPs to the new Ethernet adapter.

- Remove USB modules
 - o Run the commands below in ESX servers to unload the USB modules:
rmmod usb-uhci
rmmod ehci-hcd
 - o Restart the ESX servers.

XI. CONCLUSIONS

Leveraging the entire value of running an application such as intelliSUITE in a virtual environment like VMware is crucial. For corporations looking to deploy similar applications under these conditions, it would be wise to collaborate with all of the parties involved, including the software vendor, the virtual environment solution provider and the organizations' internal IT to determine the best methods to achieve optimization. Corporations that implement a solution that has been tested to meet certain standards in a specific environment (such as VMware) can look to receive to a number of benefits. It could also be considered a best practice to work with software vendors that have achieved specific certifications regarding optimal performance running in a virtual environment.

The testing and collaboration that takes place prior to any such certification being granted is thorough and reliable. These testing scenarios ensure that optimal settings for the virtual infrastructure are achieved long before the particular application or software is implemented at an organization. By moving forward with a virtual environment certified solution such as intelliSUITE running on VMware, corporations and organizations can be confident they will achieve peak performance from day one.

Furthermore, working with both the software vendor (in this case SunGard) and VMware to optimize the infrastructure also opens up other avenues for increasing efficiency. Organizations can take the opportunity to make sure they have effective data recovery processes, provisioning, change management, backup systems and more. Overall, following the practices determined by the collaborative efforts of SunGard, Intel, HP and VMware when implementing and running intelliSUITE can lead to lower TCO, increased flexibility and better performance.

XII. APPENDIX A ADDITIONAL PERFORMANCE DATA

The table below details the native (physical) hardware environment that the tests were run against. Among the other key performance indicators that were mentioned in the virtual environment, the utilization of various resources (CPU, Memory and Network) was found to be less than 43% and the response was under 28 seconds for all transactions through out the tests.

Web Server 1	2 - Intel Xeon Quad Core – 3.16 Ghz 32 GB Ram 140 GB HDD
Web Server 2	2 - Intel Xeon Quad Core – 3.16 Ghz 32 GB Ram 140 GB HDD
App Server 1	2 - Intel Xeon Quad Core – 3.16 Ghz 32 GB Ram 140 GB HDD
App Server 2	2 - Intel Xeon Quad Core – 3.16 Ghz 32 GB Ram 140 GB HDD
Database Server	2 - Intel Xeon Quad Core – 3.16 Ghz 32 GB Ram 140 GB HDD
Load Runner Generator	Intel Xeon Dual Core – 3.60 Ghz 4 GB Ram 70 GB HDD
Network Speed	1 Gbps

ABOUT INTEL

Intel (NASDAQ: INTC), the world leader in silicon innovation, develops technologies, products and initiatives to continually advance how people work and live. Additional information about Intel is available at www.intel.com/pressroom and blogs.intel.com.

ABOUT HEWLETT PACKARD

HP, the world's largest technology company, simplifies the technology experience for consumers and businesses with a portfolio that spans printing, personal computing, software, services and IT infrastructure. More information about HP (NYSE: HPQ) is available at <http://www.hp.com>.

ABOUT VMWARE

VMware (NYSE: VMW) is the global leader in virtualization solutions from the desktop to the datacenter. Customers of all sizes rely on VMware to reduce capital and operating expenses, ensure business continuity, strengthen security and go green. With 2008 revenues of \$1.9 billion, more than 130,000 customers and more than 22,000 partners, VMware is one of the fastest growing public software companies. Headquartered in Palo Alto, California, VMware is majority-owned by EMC Corporation (NYSE: EMC). For more information, visit www.vmware.com.

www.sungard.com/ambit

ABOUT AMBIT

Sungard's Ambit is a banking solution suite for retail, commercial and private banks. It provides banking professionals with solutions that support front-, middle- and back-office operations, as well as solutions for financial management, risk and compliance. Ambit helps banks improve customer service management, streamline business processes, comply with regulations and capture growth opportunities.

For more information, visit www.sungard.com/ambit.

ABOUT SUNGARD

With annual revenue of \$5 billion, SunGard is a global leader in software and processing solutions for financial services, higher education and the public sector. SunGard also helps information-dependent enterprises of all types to ensure the continuity of their business. SunGard serves more than 25,000 customers in more than 50 countries, including the world's 25 largest financial services companies.

Visit SunGard at www.sungard.com.

© 2009 SunGard.

SunGard, the SunGard logo and Ambit are trademarks or registered trademarks of SunGard Data Systems Inc. or its subsidiaries in the U.S. and other countries. All other trade names are trademarks or registered trademarks of their respective holders.