Your Company

Virtualization Readiness Assessment

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Confidentiality

All information supplied to YOUR COMPANY for the purpose of this proposal is to be considered Intelinet Systems confidential.

1 Executive summary

The Virtualization Readiness Assessment (VRA) is designed to enable YOUR COMPANY an effective way to evaluate the impact of virtual infrastructure within their environment and to highlight the benefits of virtualization.

More specifically, it explores leveraging a virtual infrastructure to address the specific needs of reducing server sprawl, maintaining manageable work capacities, and controlling the direct and downstream costs as a result of server growth and end-of-life server replacement needs.

The VRA focuses on the consolidation of servers through virtualization. Though there are other types of consolidation, such as with applications and resources, those consolidation types are outside the scope of this assessment and will not be addressed.

The VRA used a highly automated data collection process to gather information on # servers in YOUR COMPANY's environment. In turn, Intelinet Systems combined this information with experienced consulting and professional services to analyze the information and report the findings.

The findings were typical of most environments in that a large percentage of the servers are underutilized and are candidates for consolidation through virtualization as shown in Figure 1.1

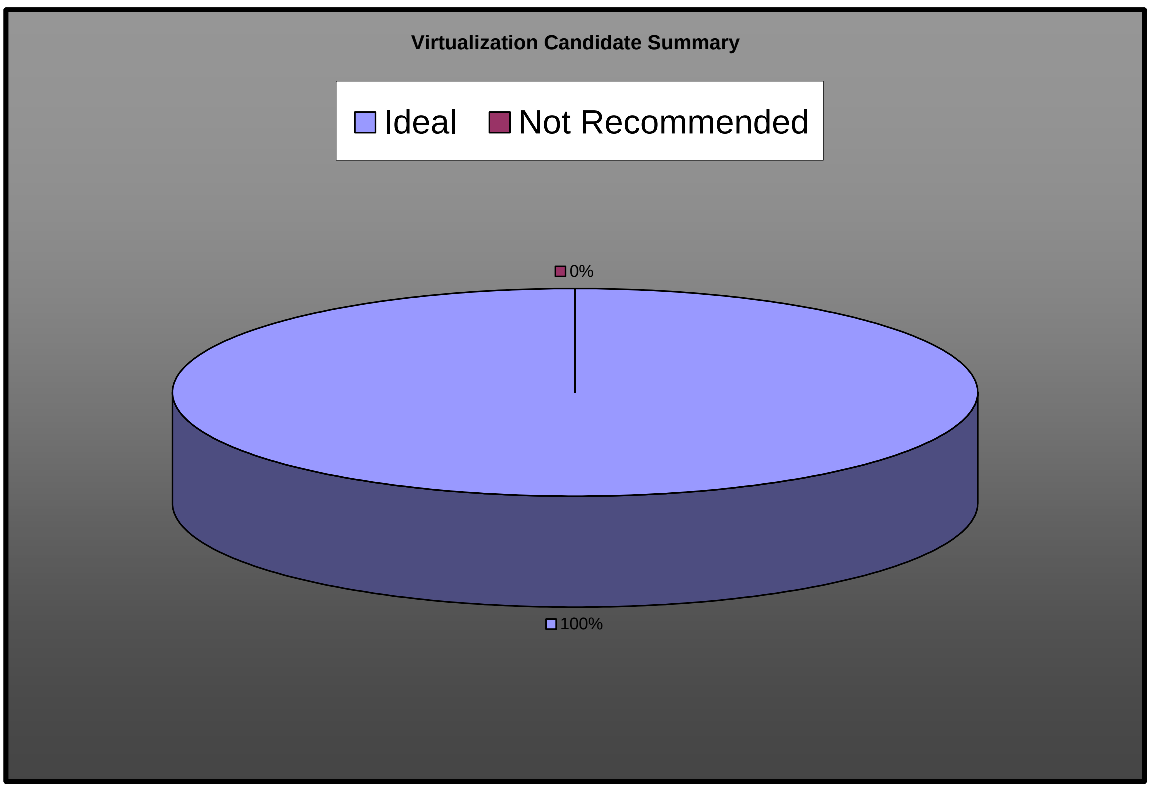

Figure 1.1 - Virtualization Candidate Summary

Figure 1.2 and Figure 1.3 below help to illustrate how deploying servers and applications in a traditional 1:1 ratio of servers to hardware will cause an organization to over purchase memory and computing power.

Figure 1.2 shows the total amount of memory available versus the average amount of memory actually used. On average, approximately 61% of the RAM purchased is not being utilized.

The same underutilization can be observed by looking at the available computer power (CPU MHz) in Figure 1.3. It reveals that an average of 98% of purchased computing power is not being used.

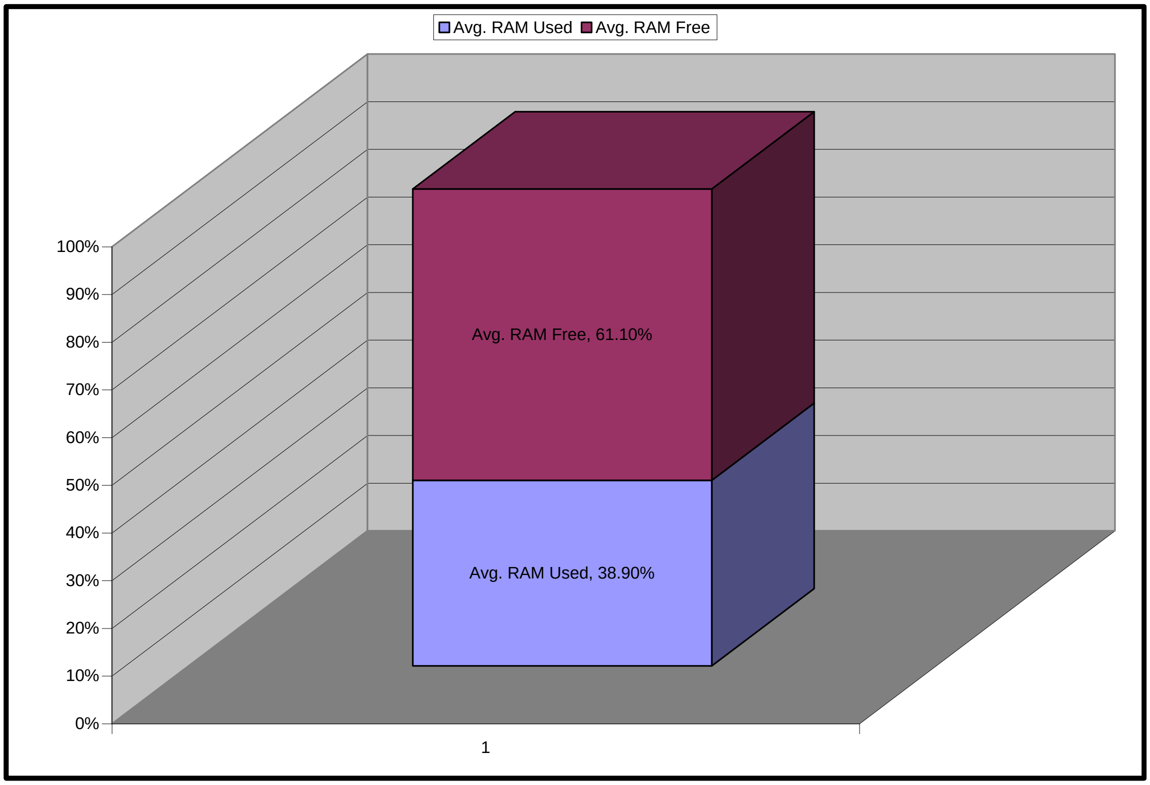

Figure 1.2 - Memory Consumption Summary

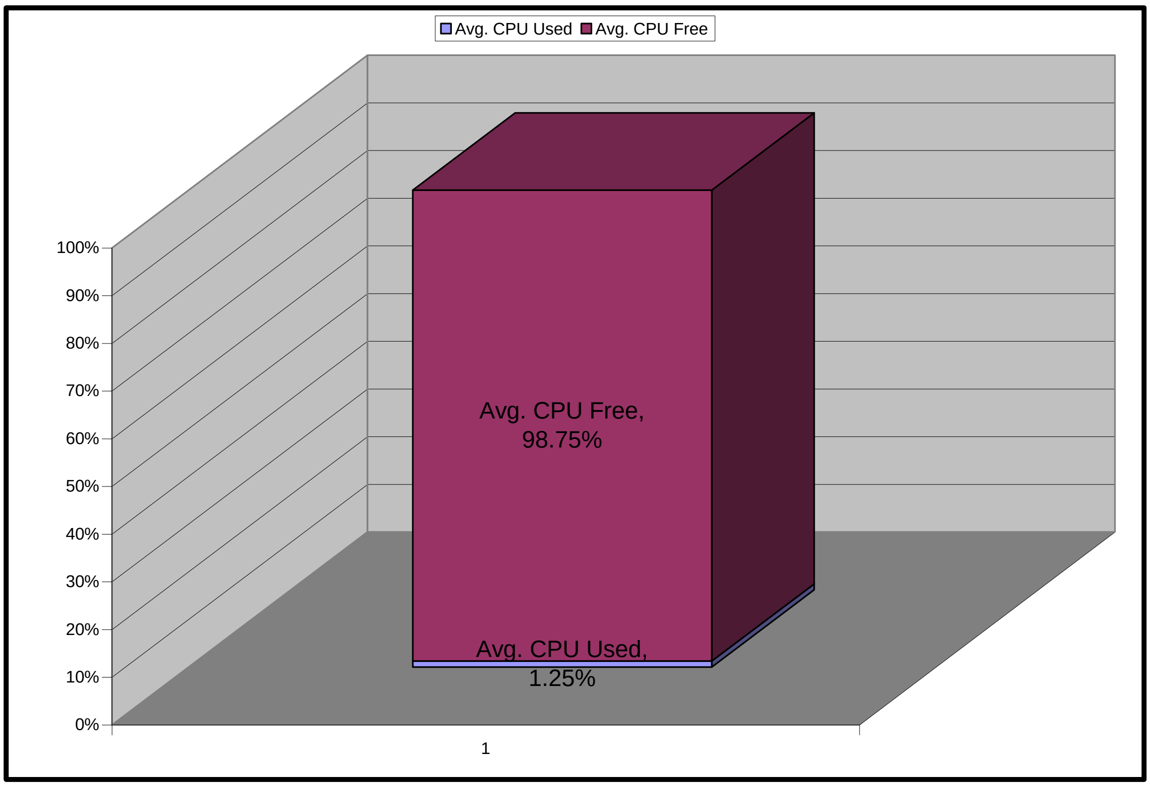

Figure 1.3 - CPU Usage Summary

NOTE: *EXAMPLE BASED ON 26 SERVERS*

By deploying virtualization within YOUR COMPANY's environment, the following benefits can be realized when compared to an equivalent traditional deployment.

- 26 of the 26 servers analyzed would be candidates for virtualization.
- YOUR COMPANY will realize up to a 77% reduction of the target servers.
- 26 servers can be reduced to:
    - (2) 2-way Quad Core servers with 32G of RAM
    - For the purposes of this assessment we will be comparing the cost and value of 6 ESX server to comparable traditional infrastructure.
- Free up approximately 4 racks which will reduce power and cooling costs of approximately $58,508/yr
- Project investment of $272,338 would be recouped in 24 months
- Hard Cost savings over a 3 year period would be $435,834

2 Virtual Infrastructure Overview

2.1 Virtualization

Virtualization is provided through introducing a new Hypervisor layer to the standard X86 server platform, providing a consistent platform for development, testing, delivery and support of application workloads from the developer desktop to the workgroup to the data center.

Virtualization provides the each virtual machine an independent and complete set of virtual hardware; the guest operating system and applications (those operating inside a virtual machine) can never directly determine which specific underlying physical resources they are accessing, such as which CPU they are running on in a multiprocessor system or which physical memory is mapped to their pages. The virtualization of the CPU incorporates direct execution: instructions are executed by the hardware CPU without overheads introduced by emulation.

The virtual machine layer provides an idealized machine that is isolated from other virtual machines on the system. It provides the virtual devices that map to shares of specific physical devices; these devices include virtualized CPU, memory, I/O buses, network interfaces, storage adapters and devices, human interface devices, BIOS and others.

Each virtual machine runs its own operating system and applications; they cannot inadvertently talk to each other or leak data, other than via networking mechanisms similar to those used to connect separate physical machines. This isolation allows users of VMware software to build internal firewalls or other network isolation environments, allowing some virtual machines to connect to external facing DMZ environments while others are connected only to internal networks or other virtual machines.

2.2 CPU Virtualization

Each virtual machine appears to run on its own CPU, or set of CPUs, fully isolated from other virtual machines, with its own registers, translation look aside buffer, and other control structures. Most instructions are directly executed on the physical CPU, allowing compute-intensive workloads to run at near-native speed. Privileged instructions are performed safely by the patented and patent-pending technology in the virtualization layer.

2.3 Memory Virtualization

While a contiguous memory space is visible to each virtual machine, the physical memory allocated may not be contiguous. Instead, noncontiguous physical pages are remapped efficiently and presented to each virtual machine. Some of the physical memory of a virtual machine may in fact be mapped to shared pages, or to pages that are unmapped or swapped out. This virtual memory management is performed by the Hypervisor without the knowledge of the guest operating system and without interfering with its memory management subsystem.

2.4 Disk Virtualization

Support of disk devices in a virtual infrastructure is an example of hardware independence. Each virtual disk is presented as a SCSI drive connected to a SCSI adapter. This device is the only disk storage controller used by the guest operating system, despite the wide variety of SCSI, RAID and Fibre Channel adapters that might actually be used in the system.

This abstraction makes virtual machines at once more robust and more transportable. There is no need to worry about the variety of potentially destabilizing drivers that may need to be installed on guest operating systems, and the file that encapsulates a virtual disk is identical no matter what underlying controller or disk drive is used.

Virtual Infrastructure can be used effectively with storage area networks (SANs). Common host bus adapters allow a host server computer to be connected to a SAN and to see the disk arrays on the SAN.

2.5 Network Virtualization

You may define multiple virtual network cards within each virtual machine. Each virtual network card has its own MAC address and may have its own IP address (or multiple addresses) as well. Virtual network interfaces from multiple virtual machines may be connected to a virtual switch. Each virtual switch may be configured as a purely virtual network with no connection to a physical LAN, or may be bridged to a physical LAN via one or more of the physical NICs on the host machine.

2.6 Software Compatibility

In Virtual Infrastructure architecture, guest operating systems interact only with the standard x86-compatible virtual hardware presented by the virtualization layer. Because applications interact only with their guest operating system, and not the underlying virtual hardware, once operating system compatibility with the virtual hardware is established, application compatibility is not an issue.

3 VRA Objectives

The Virtualization Readiness Assessment strived to determine how a virtual infrastructure can be leveraged in YOUR COMPANY environment to reduce server count, contain server sprawl, and provide a means for YOUR COMPANY to be more responsive in server deployment and maintain a higher level of server uptime.

The specific goals for this engagement are:

- Provide a Total Cost of Ownership (TCO) for deploying the consolidation scenarios.
- Identify the servers that are good candidates for migration into virtual machines.
- Understanding server performance and utilization rates of 26 servers specified by YOUR COMPANY.
- Provide guidance to YOUR COMPANY as they move forward with their virtualization initiative.

4 Server Inventory Summary

This section provides a summary of server inventory. Please see appendix A for detailed server inventory information.

4.1 Processor Breakdown

Here is a breakdown of servers according to the number of CPUs each contains.

Server Count

CPU(s)	Servers
1	9
2	16
4	1
Total Servers	26

As you can see, the majority of the systems are dual-processors. This is comparable to other YOUR COMPANYs of similar size and complexity.

4.2 Operating System Breakdown

Here is a breakdown of the systems by operating system.

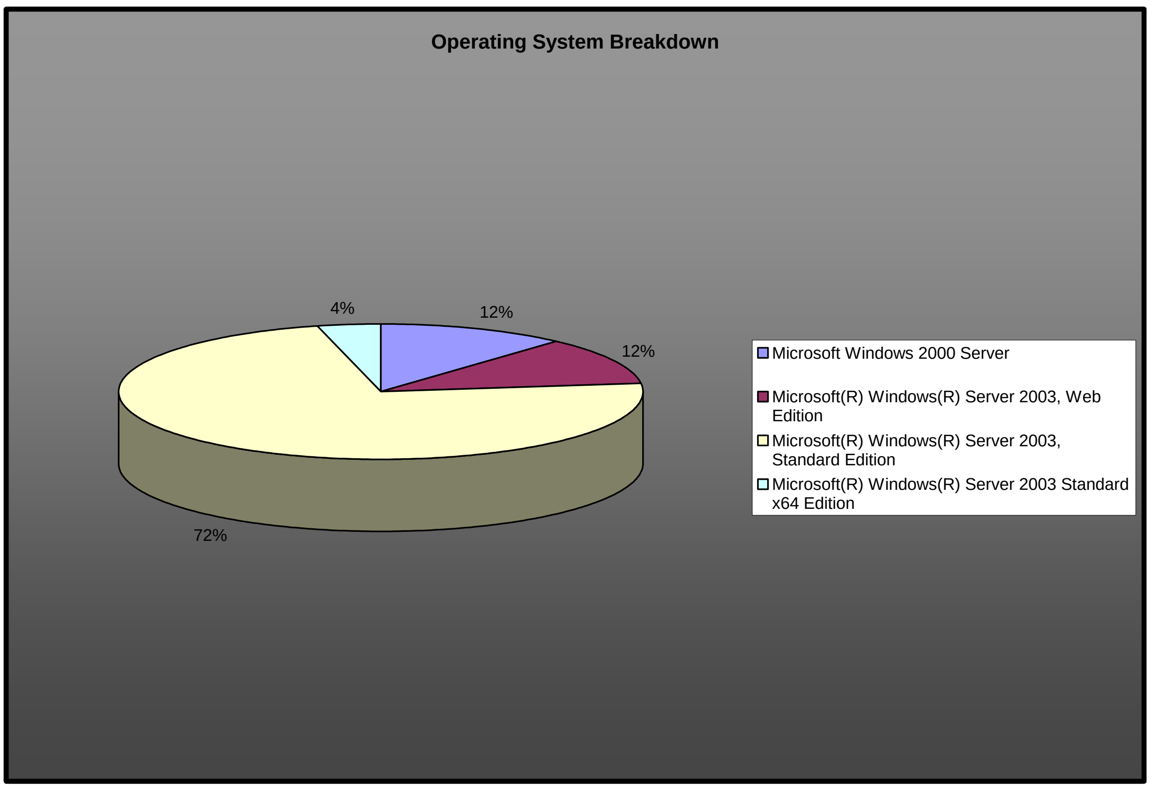

Figure 4.1 – Operating System Breakdown

In this assessment the majority of the machines are running Microsoft Windows Server 2003 Standard Edition. It might be advisable to evaluate licensing Microsoft Windows Server Datacenter Edition and leverage its **unlimited virtualization** and **downgrade rights**.

The number of permitted instances for each Operating System license

Operating System	Permitted instances in physical and virtual operating system environments on a single server
Windows Server 2008 Standard	1* + 1
Windows Server 2008 Enterprise	1* + 4
Windows Server 2008 Datacenter	Unlimited
Windows Small Business Server 2008 Standard	1* or 1
Windows Server 2003 for Small Business	1* or 1

**If running the maximum allowed instances, the instance in the physical operating system environment may only be used to run hardware virtualization software, provide hardware virtualization services, or run software to manage and service operating system environments on the licensed server.*

Per Microsoft Product Use Rights Oct. 2008

> "You may run on the licensed server an instance of Standard or Enterprise in place of Datacenter and Datacenter without Hyper-V in any of the operating system environments."

4.3 Utilization Assessment

The graph below highlights the number of servers at Prime and Peak CPU Utilization. As you can see, all of the systems monitored are reporting business hour CPU utilization at < 60%. This would indicate that 100% of the systems monitored are candidates for virtualization.

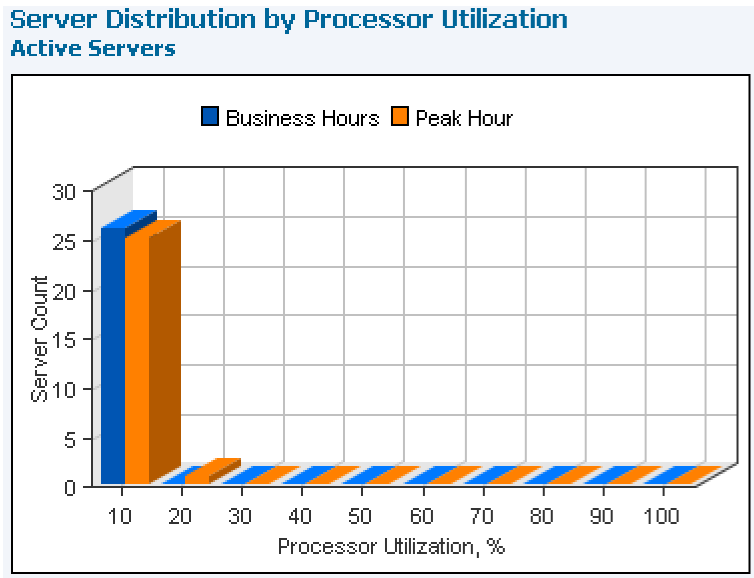

Figure 4.2 – Server Distribution by Processor Utilization

5 Guideline for Exclusion

No Systems were excluded do to the following systems requirements. Systems were excluded from virtualization based the cumulative effect of meeting one or more of the following Guidelines for Exclusion.

1. Memory utilization greater that 64 GB.
   a. Each virtual machine can be configured to a maximum of 64 GB of RAM. To allow room for growth any system that on average required more than 64 GB of memory was excluded
2. Computing power (Mhz) greater than 3000 Mhz
   a. ((CS*CN)*AU)
   b. CS=CPU Speed in Mhz of virtualization candidate
   c. CN=Number of CPU's in virtualization candidate
   d. AU=Percent Average Utilization of virtualization candidate
   e. Example; ((1200[Mhz]*2[CPUs])*80[% utilization]=1920 Mhz
3. Network usage greater than 300 Mb/sec
4. Disk IOps greater than 2000
   a. Although Disk IOps alone are not true measure of disk performance, high IOps raises a flag that more investigation into performance should be performed.

6 Consolidation Scenarios

All analyzed servers are members of one domain and are located in the same physical location. Because of this, the consolidation scenarios will look at the 26 servers as one group.

Several systems were identified for this consolidation scenario; Brand X System with 32GB's of RAM was identified as the target server for consolidation scenarios. The new server makes use of the new AMD Quad Core CPUs.

6.1 Brand X Server with 32GB of RAM

As demonstrated by the information in Figure 6.1, by using 32GB's of RAM in each server, a total of 2 ESX servers would be required to consolidate the targeted servers. The information in Figure 6.1 indicates the limiting factor for each ESX server is the Memory Usage. While the memory has reached the threshold, the Proc Usage remains relatively low. This particular scenario does result in the optimum balance of resource utilization and indicated this scenario is recommended.

Server Name	CPUcnt	Speed	RAM	NICSpeed	MHzLoad	RAMLoad	Disk I/O
Phantom2-1	4	3000	32768	4000	9.60%	26.23%	485.44
Phantom1-1	4	3000	32768	4000	23.05%	48.91%	611.1

Figure 6.1 – Projected ESX Server Requirements

Server Name	Placed On	Server Name	Placed On
DB1	Phantom1-1	DB2	Phantom2-1
CS4	Phantom1-1	CS1	Phantom2-1
VS2	Phantom1-1	HS1	Phantom2-1
YARDI-WEB1	Phantom1-1	YARDI-WEB2	Phantom2-1
YARDI-WEB3	Phantom1-1	FS1	Phantom2-1
VS1	Phantom1-1	DB3	Phantom2-1
NMS2	Phantom1-1	NMS1	Phantom2-1
DS1	Phantom1-1	CS2	Phantom2-1
WEB1	Phantom1-1	NLB01	Phantom2-1
WEB4	Phantom1-1	CONDUCTOR	Phantom2-1
WEB7	Phantom1-1	TS1	Phantom2-1
PS1	Phantom1-1	BES1	Phantom2-1
CS3	Phantom2-1	WEB8	Phantom2-1

Figure 6.2 – Server Placement on ESX Server

7 Recommendations

Intelinet Systems recommends that YOUR COMPANY proceed with a conservative virtualization initiative. The benefits and cost savings provided by virtualization would be substantial. The biggest cost savings could be realized from not having to replace 26 servers coming off lease warranty through in 2008. And/or having to buy extended warranties for those servers while they are being replaced over a two year period. Additional cost savings would come from reduced power and cooling requirements. Additional feature benefits provided by virtualization are high availability, redundancy, and disaster recovery. The recommended server platform that would achieve the highest consolidation ratios in conjunction with providing the best resource utilization would consist of (2) Servers configured with 32GB's of RAM.

Server Name	CPUcnt	Speed	RAM	NICSpeed	MHzLoad	RAMLoad	Disk I/O
Phantom2-1	4	3000	32768	4000	9.60%	26.23%	485.44
Phantom1-1	4	3000	32768	4000	23.05%	48.91%	611.1

Figure 7 – Servers with – 16GB RAM Scenario

8 Total Cost of Ownership

The following 3 year TCO is based on an expected 3 year refresh cycle for servers. In this TCO and ROI analysis we will compare the costs of a VMware Virtual Infrastructure to the costs associated with a traditional 1 machine to 1 physical box deployment.

For this TCO and ROI analysis we will be evaluating the costs involved in implementing, maintaining, and optimizing of 6 ESX server instead of the minimum required of 2 to more accurately reflect YOUR COMPANY's IT roadmap.

3 Year Total Cost of Ownership

	Without VMware	With VMware	Savings
Direct Costs			
VMware Services	$0	$11,840	($11,840)
VMware Software & Support	$0	$69,126	($69,126)
Third Party Software & Support	$0	$11,600	($11,600)
Server Hardware	$312,000	$70,427	$241,573
Network Costs	$15,600	$5,600	$10,000
SAN Costs	$0	$80,632	($80,632)
Total Direct Costs	$327,600	$249,224	$78,376
Indirect Costs			
Data Center	$193,100.05	$17,577	$175,523
Server Administration	$13,052	$3,514	$9,538
Total Indirect Costs	$206,152	$21,091	$185,061
Total Cost of Ownership	$533,752	$270,316	$263,436

Figure 8.1 – 3 Year TCO (Total Cost of Ownership)

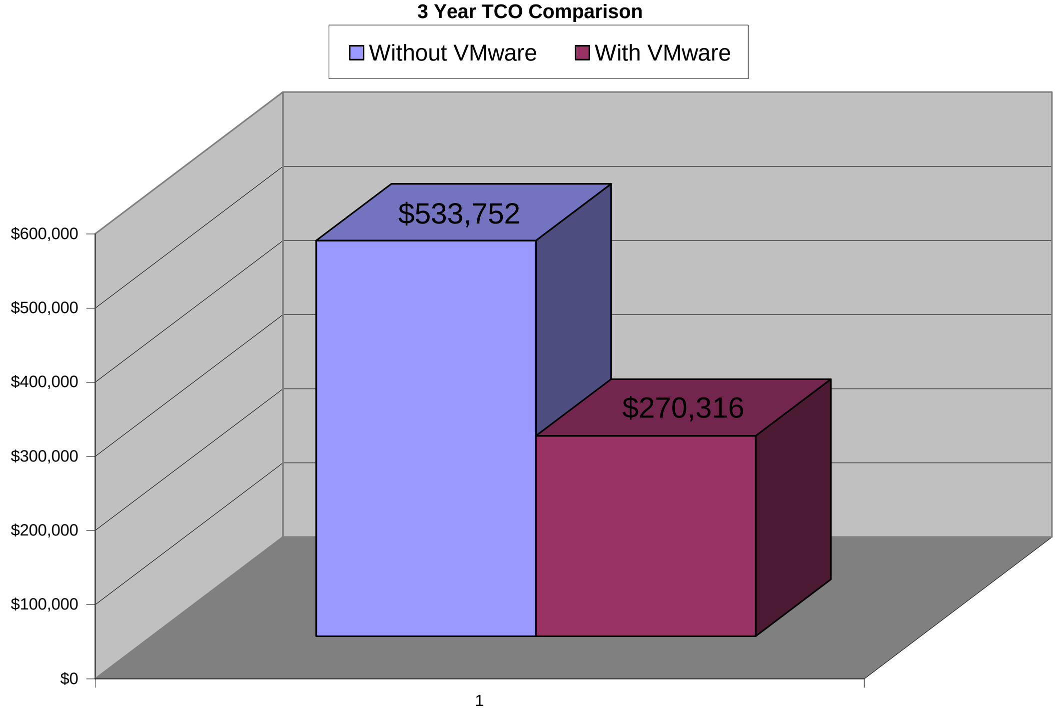

Figure 8.2 – 3 Year TCO Comparison (Chart)

Return On Investment

	Year 1	Year 2	Year 3
Investments			
VMware Services	$14,400	$0	$0
VMware Software & Support	$69,126	$9,877	$9,877
Third Party Software & Support	$11,600	$0	$0
Server Hardware	$70,427	$0	$0
Network Costs	$6,400	$0	$0
SAN Costs	$80,632	$0	$0
Total Investments	$252,584	$9,877	$9,877
Savings			
Server Hardware	$33,573	$104,000	$104,000
Network Costs	$9,200	$0	$0
Data Center	$58,508	$58,508	$58,508
Server Administration	$3,179	$3,179	$3,179
Total Savings	$104,460	$165,687	$165,687
Total Cumulative Investments	$252,584	$262,461	$272,338
Total Cumulative Savings	$104,460	$270,147	$435,834
Total Return on Investment	**41%**	**103%**	**160%**

Figure 8.3 – 3 Year ROI (Return on Investment)

9 Next Steps

The next step of this engagement will be conducting a Proof-of-Concept for YOUR COMPANY. The Proof of Concept will demonstrate more thoroughly some of the advanced features of a Virtual Infrastructure environment in YOUR COMPANY's environment, validate functionality, and demonstrate the potential impact that Virtual Infrastructure can have within an Organization.

Following successful completion of the Proof-of-Concept, or assuming that it is determined unnecessary, additional discussion and planning will be required to finalize the following areas of the Virtual Infrastructure design:

1. Virtual Infrastructure Assessment
2. Physical Design
    a. Virtual Infrastructure Diagrams
    b. Server Hardware
    c. Networking
    d. Storage
3. Logical Design
4. Naming Conventions
5. Virtual Machines
6. Server Provisioning
7. Migrations – Physical to Virtual
8. Security Management
9. High Availability
10. Monitoring
11. Maintenance
12. Backup/Restore and Disaster Recovery
13. Service Level Agreements
14. Problem Management
15. Performance Management
16. Capacity Planning
17. Change Control
18. Software Distribution & Patch Management
19. Asset Management
20. Version & Release Management
21. Chargeback
22. Training
23. Implementation Plan
24. Complementary Product Overviews
25. Best Practices

10 Appendix A – Server Inventory

The following table lists all the servers that were included in the VRA, their individual resources and characteristics. Combined, these servers make up the group for which recommendations and modeling scenarios were based on.

Server	CPUs	CPU Speed	Total Mhz	RAM (MB)	Disk Size (GB)	NIC (Mbs)	Power (W)	Cooling (BTU/hr)
BES1	1	2,992	2,992	512	43	N/A	N/A	N/A
CONDUCTOR	1	3,000	3,000	1,024	80	2,000	236.9	808.3
CS1	2	2,992	5,984	2,048	73	2,000	442.4	1,509.50
CS2	2	2,788	5,576	2,048	36	1,000	541.6	1,847.90
CS3	2	3,056	6,112	2,048	109	1,000	541.6	1,847.90
CS4	2	2,992	5,984	4,096	513	2,000	713.9	2,435.80
DB1	4	2,993	11,972	8,192	1,296	N/A	878	2,995.70
DB2	2	2,992	5,984	4,096	586	2,000	713.9	2,435.80
DB3	2	2,793	5,586	2,048	109	2,000	507.9	1,733.00
FS1	2	2,990	5,980	4,096	440	N/A	900	3,070.80
HS1	2	2,992	5,984	2,048	146	N/A	511.6	1,745.60
NLB01	1	3,391	3,391	1,024	80	2,000	N/A	N/A
NMS2	2	2,793	5,586	2,048	989	1,000	457.6	1,561.30
PS1	1	2,991	2,991	1,024	17	N/A	N/A	N/A
TS1	1	2,992	2,992	1,024	17	N/A	N/A	N/A
VS1	2	2,793	5,586	4,096	182	2,000	507.9	1,733.00
VS2	2	2,992	5,984	4,096	292	N/A	495.1	1,689.30
WEB1	1	2,992	2,992	1,024	120	1,000	N/A	N/A
WEB4	1	2,992	2,992	1,024	120	1,000	N/A	N/A
WEB7	1	2,992	2,992	1,024	120	1,000	N/A	N/A
WEB8	1	2,992	2,992	384	17	1,000	N/A	N/A
YARDI-WEB1	2	2,992	5,984	2,048	73	2,000	442.4	1,509.50
YARDI-WEB2	2	2,992	5,984	2,048	73	2,000	442.4	1,509.50
YARDI-WEB3	2	2,992	5,984	2,048	73	2,000	442.4	1,509.50
DS1	2	2,793	5,586	1,024	73	2,000	507.9	1,733.00
NMS1	2	2,793	5,586	2,048	214	2,000	713.9	2,435.80

11 Appendix B–Additional Considerations

11.1 Storage Area Network (SAN)

11.1.1 SAN assessment

A SAN is not a requirement to start the process of server consolidation through virtualization. However, a SAN is a requirement to take advantage of certain high-level functions of VMware, such as VMotion, and to fully realize the capabilities in regards to disaster recovery and business continuance.

11.1.2 SAN recommendations

It is recommended that a SAN be used in conjunction with a virtual infrastructure implementation. The diagram below depicts a typical HA SAN configuration where there exists no single point of failure on the storage communication paths.

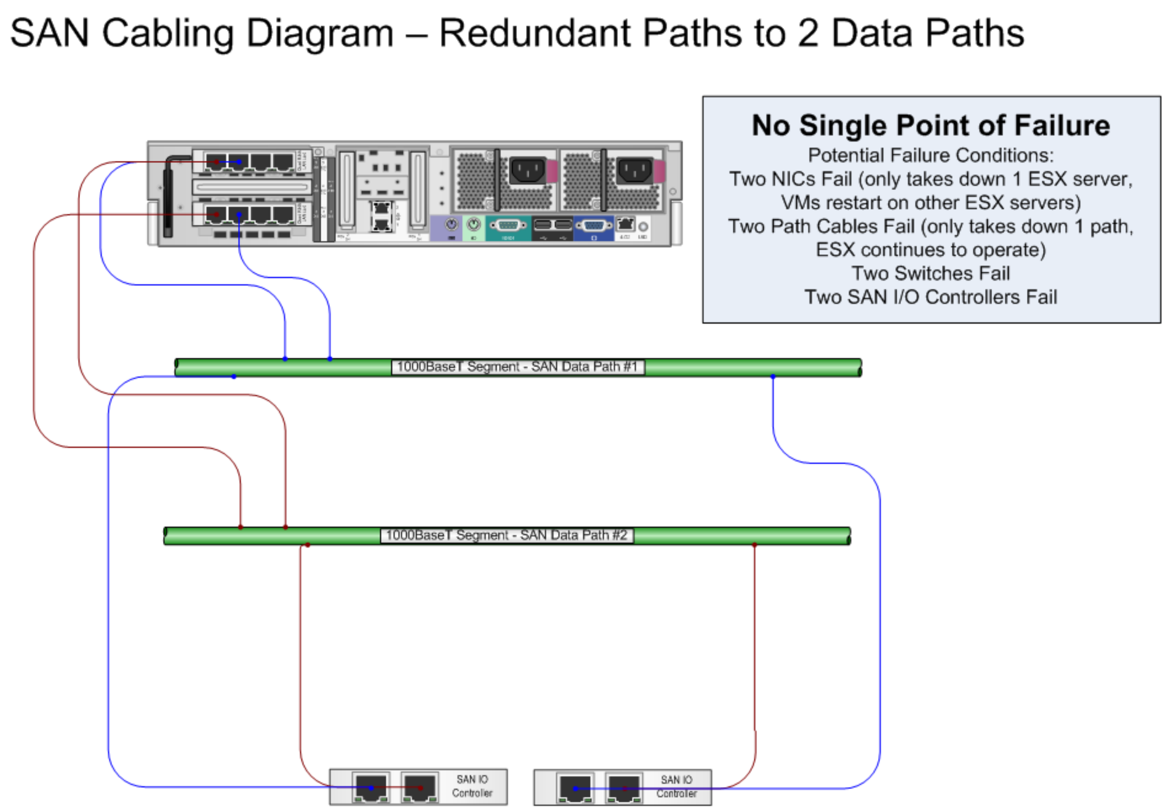

Figure 11.1 – HA SAN Diagram

11.2 Network Infrastructure

11.2.1 Network Assessment

Multiple independent networks, NIC bonding, and virtual switches are commonly implemented in a virtual infrastructure. Additionally, high performance gigabit capacity is required to perform such higher functions such as VMotion. The diagram below depicts a typical HA network configuration.

LAN Cabling Diagram – Redundant Paths to Multiple Switches

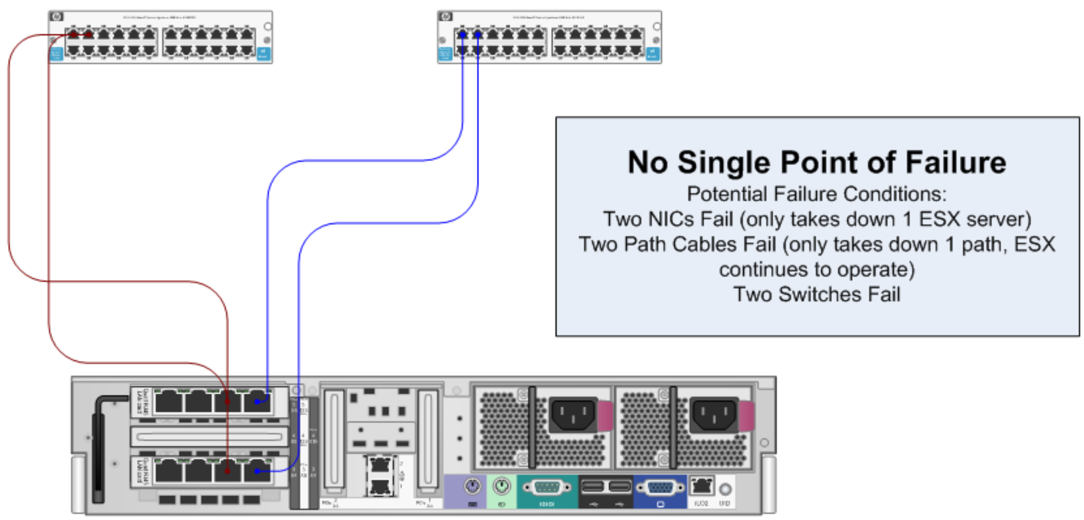

Figure 11.2 – HA LAN Diagram

11.3 Deployment and Migration

The deployment of the virtual infrastructure should be approached as a structured effort in order to insure success. There are two primary components to a virtual infrastructure deployment; installation of new infrastructure and migration of current physical servers to the virtual infrastructure. Often, when existing server platforms are going to be re-deployed in the virtual infrastructure, virtual machine server states are moved from host to host to support the transition effort. Specifically, the following major areas must be addressed to insure a successful migration and deployment:

- **Virtual Infrastructure design blueprint**
- **Virtual Infrastructure jumpstart**
- **Physical to Virtual (P2V) migration services**
- **Best practices knowledge transfer**

11.4 Training Requirements

Virtual Infrastructure will effect every employee in the IS department. The levels of interaction will be different for each group.

Table 2. Training Requirements

Group	Interaction Type	Recommended Training
Network Engineers/Network Specialist	Virtual Infrastructure engineering and administration	VMware Authorized training; Virtual Infrastructure with ESX Server and VirtualCenter Shadow training with Intelinet Systems Professional Services
DBAs	Virtual Machine users. Rarely need console access, primary using application tools and Terminal Services.	Onsite admin training session by Intelinet Systems
Operations	Virtual Machine administration, reboots,	Onsite admin training session by Intelinet Systems.

	backups, server administration	Shadow training with Analysts/Intelinet Systems
Software Engineers/Developers	Virtual Machine users. Rarely need console access, primary using application tools and Terminal Services. Potentially may use console tools to manage snapshots or undoable disks.	Onsite admin training session by Intelinet Systems. Ongoing support by Analysts
Technical Support	Virtual Machine users. Rarely need console access, primary using application tools and Terminal Services.	Onsite admin training session by Intelinet Systems.