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Consolidation Assessment
Final Report

January 2009

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The Customer engaged PC Connection to conduct a server consolidation analysis to help determine how a server consolidation would benefit the Customer and to evaluate a selected server consolidation scenario. The VMware Capacity Planner assessment tool ran for approximately 55 days from October 27, 2007 through December 24, 2007. Data was collected on 165 servers specified by the Customer for review and analysis during the installation. The performance data was collated and analyzed.

PC Connection developed this assessment to establish and define both the technical and financial baseline workload that exists for the identified 165 servers. Data was collected for 8 weeks on these servers. This report provides inventory and performance data for these servers.

The list of 165 servers in the Customer domain was reviewed by the Customer to verify that all servers in their data environment were consolidation candidates. Using the workload of these consolidation candidates as an input to a capacity model, several consolidation scenarios were built and then compared against the existing costs. Upon review of these possible scenarios, the Customer can then determine the feasibility of any of these as potential consolidation projects.

Also included with this report is a separate document that compares the Total Cost of Ownership (TCO) of the new consolidated environment against maintaining and growing the existing environment. This report provides all the detailed calculations behind the 3-year cost saving estimates. It demonstrates how your business can realize dramatic savings in server hardware, storage, network, data center power and cooling, real estate space, and disaster recovery by implementing VMware solutions. The report also outlines the initial investment required to purchase VMware software, receive professional training, and to assess and deploy a virtual infrastructure.

Based upon consolidating the 165 identified servers, implementing VMware products provides a potential direct savings of over $2 million and an indirect savings of over $280,000 over 3 years.

Overview

Capacity Planner found 1,463 systems on all domains at the Customer. Only 165 of these servers were inventoried to be included in this consolidation study.

Inventoried/Monitored Servers by Week
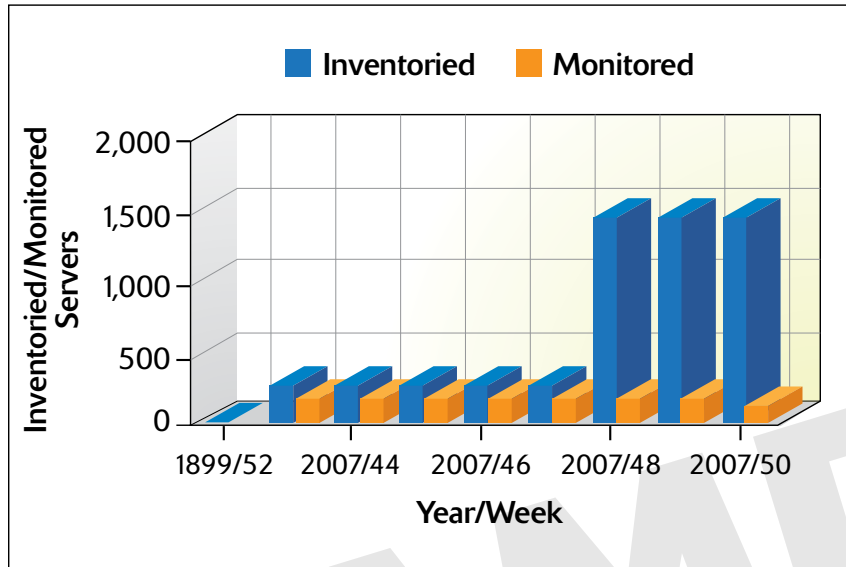
Consolidatable Servers
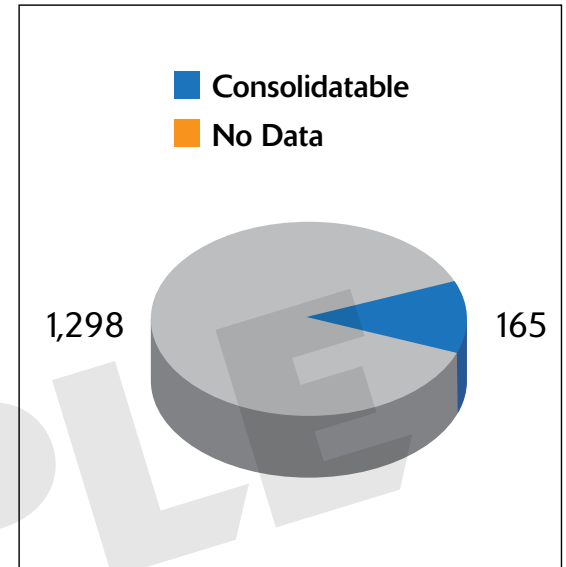
System Name	OS	Make	Model	Processors		Memory		Disk	Network
				Cnt	Speed (MHz)	Size (MB)	Size (GB)	#	Speed (MB/sec)
1	Microsoft Windows 2000 Server	HP	ProLiant DL360	2	996	1,152	36.41	2	200
2	Microsoft Windows Server 2003, Standard Edition	HP	ProLiant BL20p G2	2	2,799	512	146.81	3	3,000
3	Microsoft Windows Server 2003, Standard Edition	HP	ProLiant ML570 G4	4	3,000	2,048	807.11	2	2,000

Figure 1: Server OS Distribution

- ■ Microsoft Windows 2000 Server
- ■ Microsoft Windows Server 2003, Standard Edition
- ■ Microsoft Windows 2000
- ■ Microsoft Windows Server 2003, Enterprise Edition
- ■ Microsoft Windows NT Server
- ■ Microsoft Windows 2000 Advanced Server
- ■ Microsoft Windows 2000 Professional
- ■ Microsoft Windows Server 2003
- ■ Microsoft Windows XP Professional
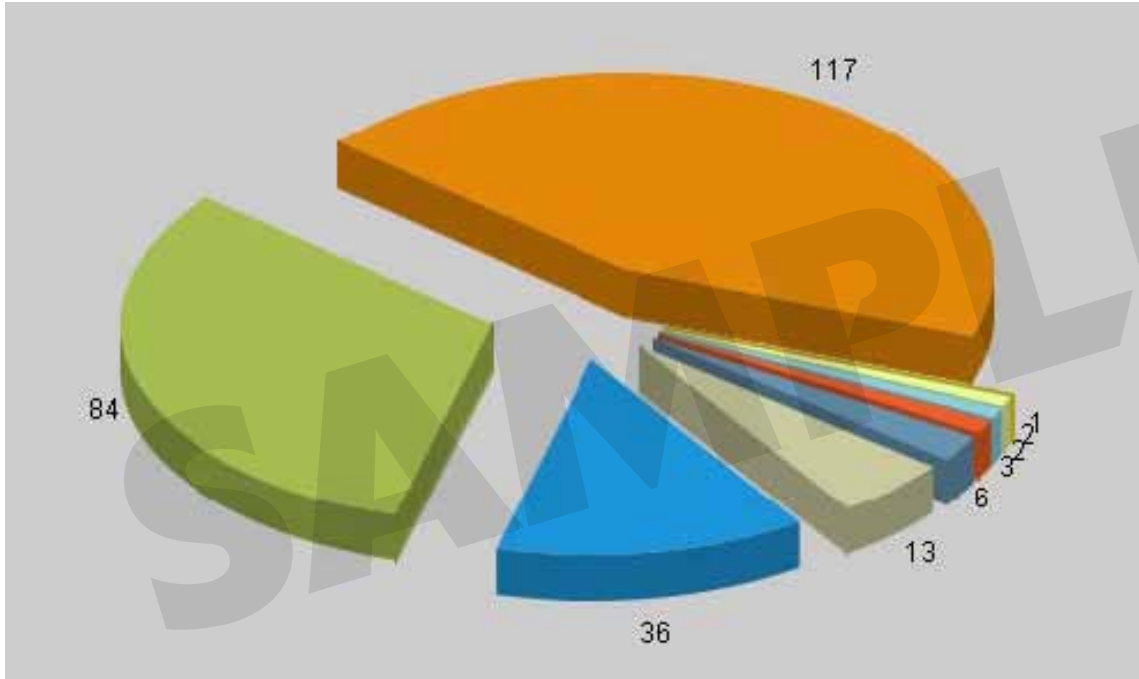
System Performance Tables

| System Name	Processors		Memory			Disk		Network
	% Used	Queue per CPU	% Used	File Sys Cache (MB)	Paging (Pg/sec)	I/O (Trans/sec)	I/O (MB/sec)	Speed (MB/sec)
1	26.51	1.00	99.85	55.34	284.04	232.96	1.17	0.04
2	2.64	0.03	80.46	121.58	0.08	4.97	0.03	0.01
3	8.80	0.01	73.70	406.87	3,446.10	501.77	30.35	0.04

Figure 3: Server Distribution by Processor Utilization

The following graph shows server distribution by processor utilization during prime hours and peak:
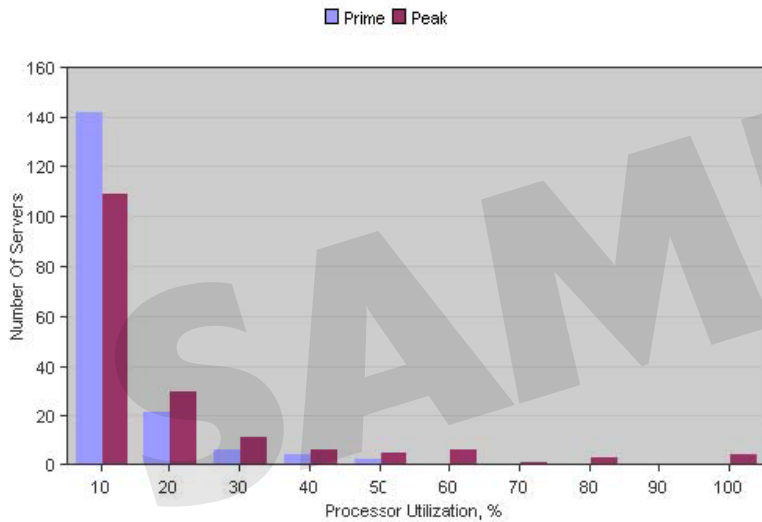
The following table is a detailed list of Processor Utilization % during Prime Hours (0700AM to 0600PM) and Peak Processor Utilization:

System Count	Processor Utilization % Prime Hours (0700AM to 0600PM)	Processor Utilization % Peak
0–10%	142	109
10–20%	21	30
20–30%	6	11
30–40%	4	6
40–50%	2	5
50–60%	0	6
60–70%	0	1
70–80%	0	3
80–90%	0	0
90–100%	0	4

Consolidation Processing Overview

After collecting performance and inventory data, information can be correlated to generate consolidation recommendations from the Capacity Planner Dashboard. These recommendations are manually initiated by a Capacity Planner Administrator and can be executed on the entire monitored group of systems or only on a specific group of systems.

Thresholds control consolidation by setting the maximum combination of loads which servers must not exceed in order to generate a successful consolidation. Capacity Planner collects many performance metrics and uses them to determine if there is a statistical fit. If the combination of loads exceeds any of these metrics, no consolidation recommendation is made.

Capacity Planner uses the peak load values when considering consolidation, not the weekly average. As statistics are received, they are evaluated to determine what hour of the day the peak load occurs in. The peak load is determined by evaluating load for a minimum of 3 weeks. The hour with the consistently highest load will be deemed the peak load hour, and its average value becomes the peak load for the server. Each server has its own peak load hour and peak load value.

The following is a list of parameters used for consolidation:

- CPU Utilization %
- CPU Queue
- Disk Busy %
- Disk Queue
- RAM Utilization %
- Page File Utilization %
- Pages/Sec
- Server Bytes/Sec

The standard threshold limits are as follows and are considered to be Capacity Planner best practices.

Threshold Parameter	Threshold Value	Comments
Prime Time Start	7:00	
Prime Time End	18:00	
CPU Utilization Max	50.0%	
Queue per CPU	4.0	
Pages/Sec Max	4,000.0	Raised from default of 200
RAM Utilization Max %	90.0%	Often referred to as RAM load
Page File Utilization Max %	70.0%	
Disk MB per Sec	50	
File System Cache (MB)	546	This threshold is not considered for VM workloads
Disk I/O Trans/sec	1,000	

Scenario Modeling

A scenario compares the current environment to the proposed technology architecture. This scenario serves as a high-level guide for server consolidation.

Server Consolidation Scenarios

Two scenarios were run. The first was with the CPU threshold set at 50% utilization. This shows 6 servers out. This is a very aggressive consolidation. The servers are highly utilized, and there is not a lot of flexibility for shutting down a server, moving VMs, etc. We also ran another scenario with the CPU threshold set at 25%. This provided an additional 2 servers out, but also provides a high consolidation ratio. Below is a chart showing the different scenarios and the number of servers in and the number of servers out. The detailed results for the 8 server out scenario can be found in Appendix A.

Note: Even though 165 servers were inventoried, only 155 were available for consolidation at the time the consolidation scenario was run on January 14, 2008.

Name	Servers In	Servers Out
HP ProLiant DL585 G2 8 CPU 64GB	155	6
HP ProLiant DL585 G2 8 CPU 64GB (25% CPU utilization)	155	8

The Capacity Planner tool will make server consolidation recommendations based solely on the data—CPU Utilization, Memory Utilization, Disk Utilization, etc. In that sense, it generates an idealized outcome—the greatest consolidation possible. True business conditions, however, often dictate different results such as critical database servers remaining as standalone servers, because sharing resources for such critical applications could be imprudent. This is why in any contemplated server consolidation plan, it is critical to adopt a strategy of replicate, validate, and implement for key application servers. This will be covered in somewhat more detail in the recommendations section of this document, but suffice to say that the number of servers that the Capacity Planner tool indicates can be consolidated is a goal and not a guaranteed outcome. Business intelligence must factor into the decision making.

The following section provides an overview of the type of server recommended as Phantom Server in the what-if scenarios.

HP ProLiant DL585 G2

|	
Processor Capacity	4 Dual-Core AMD 8200 Series Processors
Memory Type	PC2-5300 Registered DIMMs at 667MHz
Max Memory	128GB
Max Drive Bays	8 small form factor (SFF) SAS hot plug hard drives
Storage Controller	Smart Array P400/256MB Controller
Networking	2 embedded NC371 i Multifunction Gigabit Server Adapters One (1) additional 10/100 server adapter dedicated to iLO 2 Management

The Customer will analyze technology investments as they would any other business investment; therefore the best path for demonstrating that a project is worthwhile is to show a positive return on investment (ROI).

This section summarizes the financial metrics determined in this analysis. Please see the separate TCO analysis report for full details.

The projected outcome of this proposal includes:

• $2,101,373 in direct TCO savings over 3 years

• Additional $282,660 in indirect savings over 3 years

• Overall, an ROI of 719% on an initial one-time $331,452 investment

• A reduction in operating power of 53.9 kilowatts
  and a reduction of cooling power of 67 kilowatts

3 Year TCO Comparison for VMware
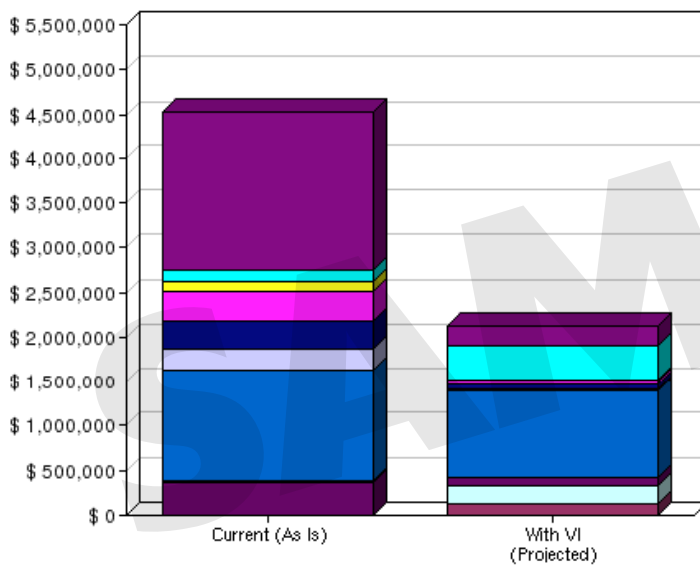
■ Data Center Server Hardware
■ Data Center Server Storage
□ Data Center Server Networking
■ Data Center Server Space
■ Data Center Server Provisioning
■ Data Center Server Administration
■ Data Center Server Disaster Recovery (Indirect)
■ Data Center Server Unplanned Downtime (Indirect)
■ VI Software Licensing and Sns
■ Additional Software Licensing Costs (if any)
■ VI Design, Plan, and Deployment Services
■ VI Training

Please note that the TCO analysis uses a conservative consolidation estimate. Based on the information provided, the projected number of new servers is 19. Capacity Planner scenario results are 6 or 8, depending on the scenario. Capacity Planner provides more specific information about the consolidation possible based on actual current server performance. The TCO model uses a very conservative estimate.

Implementation Methodology

When production consolidation takes place, PC Connection recommends that this be done using the following methodology:

1. Identify and consolidate easiest systems first (e.g. DHCP, DNS, File Servers, Print Servers, Active Directory servers). Later, other servers can be considered (small SQLservers).

2. Replicate critical servers onto target servers and test outside of production before actually running production through virtualized servers.

3. Once the performance has been verified, the server can be moved into production.

4. Particularly with production servers, the goal should not be to implement several at once—but rather to consolidate only a few at a time, verify performance, and then target additional servers.

5. Business intelligence must be applied to all potential server consolidation targets. For example, if the load on a particular server is expected to grow substantially over a period of time it may not be appropriate to consolidate that server until it reaches stability.

6. Constantly reevaluate performance of servers that have been consolidated.

PC Connection recommends virtualizing the Customer domain in planned phases beginning with the least CPU intensive servers up to the heaviest utilized servers.

Virtualization of existing physical servers should take place during non-critical business hours to ensure the least amount of disruption of normal day-to-day business requirements.

Included in Appendix B is a spreadsheet which contains a list of servers for the Customer sorted by phases.

Phase I—Blue: Servers with CPU Utilizations under 5% or CPU speeds under 1GHZ (116).

Phase II—Green: Servers with CPU Utilizations over 5% but less than 30% (27).

Phase III—Red: Servers with CPU Utilizations greater than 30% (12).

Target System Name	Source System Name(s)	Capacity — Processors Count	Processors Speed (MHz)	Memory Size (MB)	Disk Size (GB)	Network Count	Network Speed (MB/sec)	Physical Rack Units	Physical Weight (lbs)	Physical Power (W)	Physical Thermal (BTU/hr)	Processor % Used	Processor Queue per CPU	% Used	Memory File Sys Cache (MB)	Memory Page File %	Memory Paging (Pg/sec)	Disk I/O (Trans/sec)	Disk I/O (MB/sec)	Network Speed (MB/sec)
Reused Systems - None																				
Systems with Exceptions																				
❌ ADC0200A	ADC0200A	4	3,000	6,144	807.11	2	2,000.00					16.47	0.03	75.14	475.46	10.39	0.23	1,406.93	54.31	0.02
❌ CWKS02000B	CWKS0200B	1	2,398	3,600	33.05		0.00					62.39	5.00	95.81	211.62	80.57	3.27	1,902.50	2.45	0.01
All Systems		12.7 GHz		9.7 GB	840.16	2	2.0 GB	0	0	0.0 KW	0.0 Tons	25.13	0.86	83.15	687.08	45.48	3.51	3,309.43	56.76	0.04
New Systems																				
Phantom1-1 ⭐	Server Names	8	2,800	65,536	146.00	6	6,000.00	4				15.14	1.79	35.03	4,424.59	6.90	1,632.52	511.52	12.53	0.55
Phantom2-1 ⭐	Server Names	8	2,800	65,536	146.00	6	6,000.00	4				45.57	2.84	51.61	4,430.73	2.99	2,049.73	394.03	15.26	0.46