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Review Paper on Resource Optimization of Servers Using Virtualization

Sarnpreet Kaur*
M.Tech Computer Science (Student)
SKIET, Kurukshetra University
Kurukshetra, India

Ravi Bhushan
Assistant Proffesor
SKIET, Kurukshetra University
Kurukshetra, India

Abstract— In this paper, the earlier literature for Resource Optimization and Virtualization has been presented. All the ideas that are developed have been understood and review has been presented for the same. Server virtualization is a key building block that enables application isolation, mobility, and partitioning of individual servers in the cloud. Applications are placed into Virtual Machine which simplify the provisioning and configuration of application allowing for easier reconfiguration of resources to meet server demands. It has also focused on how to maximize the performance of a single physical system by introducing multiple operating systems at a time with cost minimization and efficient resource management using virtualization. Every Operating System on the Virtual Machine works as the server.

Keywords—Virtualization, Server Virtualization, Resource Optimization, etc.

I. INTRODUCTION

One of the very basic problems faced today revolves around the lack of Hardware for the processes. Virtualization has brought a revolution, and has converted pure hardware requirements to a software implementation. It is the process of separating the hardware from the operating system on a physical machine. We can understand it like a computer with in a computer. This is true all the way down to the emulation of certain types of devices, such as sound cards, CPUs, memory, and physical storage. An instance of an operating system running in a virtualized environment is known as a virtual machine. Virtualization converts all the Computer resources into pools. Depending on the needs, resources are then assigned to different applications either manually or dynamically from different pools. The scope of virtualization can vary from a single device to a large data centre and virtualization can be applied to different areas such as servers, networks, storage systems and applications. Data Centre in virtualized environment is presented in Figure 1.

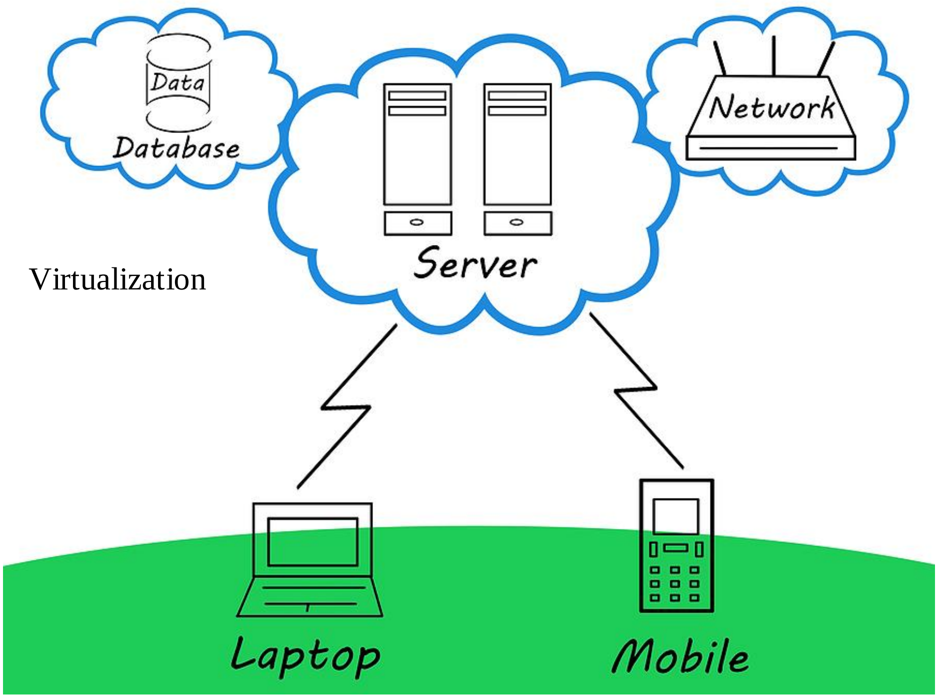

Fig 1– Server in a Virtualized Environment.

Virtualization technology allows multiple virtual machines, with heterogeneous operating systems to run side by side and in isolation on the same physical machine. By emulating a complete hardware system, from processor to network card, each virtual machine can share a common set of hardware unaware that this hardware may also be being used by another virtual machine at the same time. The operating system running in the virtual machine sees a consistent, normalized set of hardware regardless of the actual physical hardware components. There are some other types of Virtualization technologies available. For example, Computer Memory Virtualization is a software that allows a program to address a much larger amount of memory than is actually available. To accomplish this, we would generally swap units of address space back and forth as needed between a storage device and virtual memory. In computer storage management, Virtualization is the pooling of physical storage from multiple network storage devices into what appears to be a single storage device that is managed from a central console. In an environment using network Virtualization, the virtual machine implements virtual network adapters on a system with a host network adapter.

The focus of server virtualization is to create virtual machines or virtual environments by using normal server hardware and a virtual machine software. Virtual machine software enables sharing physical hardware among several instances called virtual machines. Sharing is done by creating a special virtualization layer, which transforms physical hardware into virtual devices seen by virtual machines. The most visible change is the possibility to run different operating systems (OS) within the same hardware concurrently [1][3] Figures 2 and Figure 3 illustrate the difference between physical servers and virtual servers. In the Physical Servers there are four servers. Each server has its own processor, memory, local disk and network connection whereas in Virtual Server system there is a Virtualization Layer which is based on a single Physical Server.

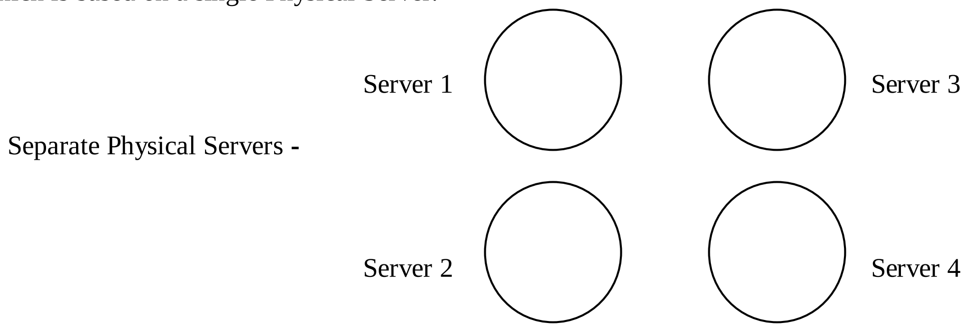

Fig. 2 – Physical Server

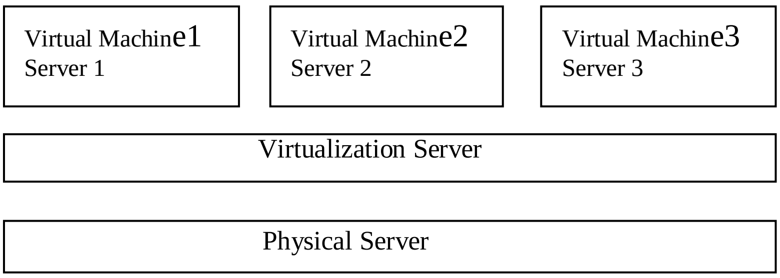

Fig 3 - Virtual Machines (VMs) and a Virtualization Layer in a single Physical Server

Features of Virtualization:

1) **Running multiple Operating Systems simultaneously**
   Virtual Box allows us to run more than one operating system at a time. This way, you can run software written for one operating system on another without having to reboot to use it.
2) **Easier Software Installations**
   Software vendors can use virtual machines to ship entire software configurations. For example, installing and running a mail server becomes as easy as importing such an appliance into Virtual Box.
3) **Testing and Disaster Recovery**
   Once a virtual machine is installed, its virtual hard disks can be considered a "container" that can be arbitrarily frozen, woken up, copied, backed up, and transported between hosts. On top of that, with the use of another Virtual Box feature called "snapshots", one can save a particular state of a virtual machine and revert back to that state, if necessary.
4) **Infrastructure Consolidation**
   Virtualization can significantly lessen hardware and electricity costs by using only a fraction of their potential power and running with low average system loads.

II. LITERATURE SURVEY – REVIEW

A. Virtualization compared to System Partitioning

The special feature of mainframe systems is different partitioning schemes. By using these schemes hardware resources can be divided into several partitions. Currently there are two main schemes that are widely used: Logical Partitioning (LPAR) and Physical Partitioning (PPAR). Logical partitioning is similar compared to virtualization, since both of these techniques describe hardware resources as pools. The terms logical partitioning and virtualization are therefore often used in the same context. A practical difference is that within mainframes, the partitioning is typically done without sharing a single processor among multiple partitions and different partitions must use the same OS. The term physical partitioning is used when resources are physically divided in the hardware level. Although resource sharing using physical partitioning is not as flexible as in logical partitioning, the partitions are fully isolated and overhead does not exist. [2][5][23].

Mainframe architecture typically consists of separate CPU/Memory cards, I/O cards and interconnection bus. Combinations of these cards are used to create a building block. An example of a server hardware that contains 4 building blocks is presented in Figure 4. The physical building blocks are the limiting factor when physical partition is created. Logical partition does not have similar limitations [2]. Figures 5 and Figure 6 present the difference between physical and logical partitioning. In Figure 5 there are two physical partitions: Physical partition 1 (3 building blocks) and Physical partition 2 (1 building block).

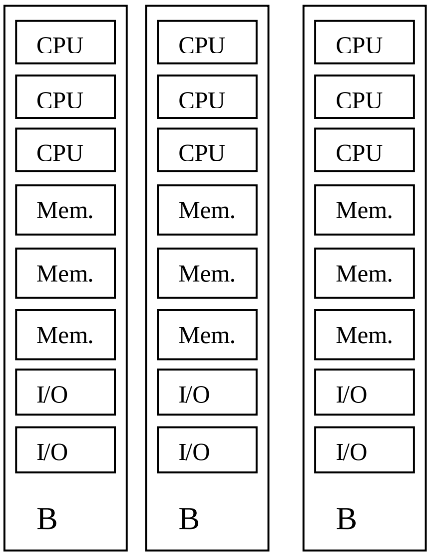

Fig 4 Building Blocks

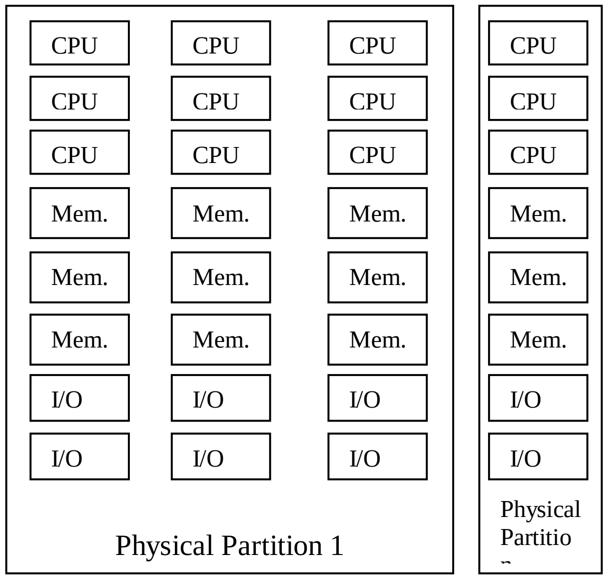

Fig 5 Physical Partitioning

Logical partitioning with three separate partitions is presented in Figure 6. This partitioning example presents the typical scheme of production and testing environments within a single physical system: both environments are separated and the production environment has more resources than the testing environment. Due to the flexibility of logical partitioning, partitions can be configured to support CPU, memory and I/O sensitive applications.

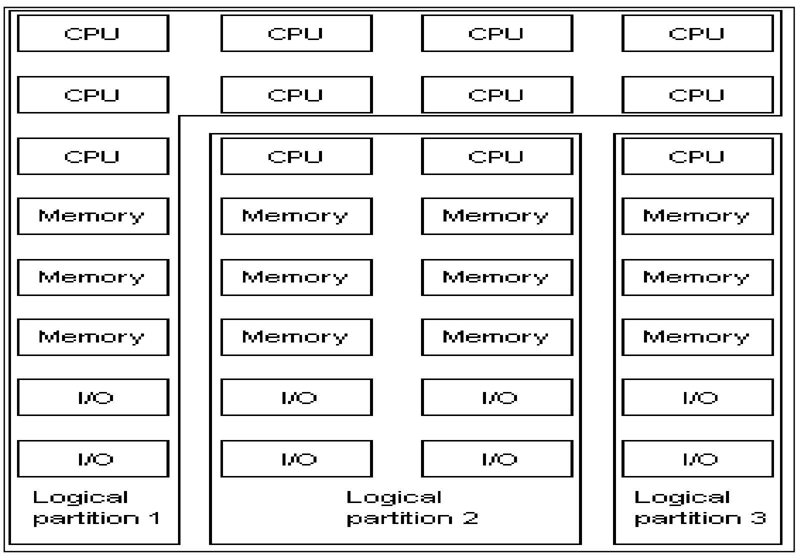

Fig 6- Logical Partitioning.

B. Server Virtualization compared to Workload Management

Server virtualization and workload management both point to the same target of using resources more efficiently and describing them as resource pools. The practical approach, however, is different. The main idea of the workload management is to provide resources to different tasks as efficiently as possible. A common solution to providing resources is to create a pool by using several physical servers and workload management software.

Instead of sharing or partitioning resources of a single physical server, the most suitable system from the resource pool is selected [8]. The common problem with workload management is its limited usage. All systems in the pool must be hardware compatible with each other and they must use the same OS. Besides hardware limitations, there are also restrictions in the software side: only those tasks can be used that the workload management software is capable of distributing. Also the whole concept of separate virtual machines and its benefits does not exist. In order to enable the distribution of tasks, a tight cooperation between the hardware, OS and workload management software is required. Usually this means that the whole system must be obtained from a single vendor. Due to these restrictions, the workload management software is commonly used only in a single vendor UNIX environment [8].

C. Server Virtualization compared to Consolidation

The term consolidation is typically used to describe a process that aims at providing existing services more efficiently and thus save costs. One part of consolidation is server consolidation, which can be divided into two different categories:

- Location consolidation. The number of physical locations containing hardware is reduced.
- Physical consolidation. The number of physical hardware is reduced. [6][10].

Server virtualization is often mentioned as a consolidation scheme or in the same context as consolidation since virtualization provides similar benefits. When applications are running in underutilized servers, the efficiency can be increased by moving applications to virtual machines and shared hardware. Virtualization software creates a hardware standard, since every virtual machine runs in an identical environment. The benefits of physical consolidation can be achieved by a migration of several physical servers into virtual machines running on single server. Virtualization makes the practical part of consolidation process easier, but location consolidation cannot be done using it. Virtual machines can be transferred as files over network instead of transferring physical hardware [23].

Server virtualization can be seen in three major roles in consolidation:

- Multiple existing systems are combined into a single system, whose resources are used efficiently (physical consolidation).
- Instead of replacing aged hardware with new, old systems are migrated to virtual machines.
- Virtualization is used to provide a platform where creating a single system or an entire environment can be done in a short time span without purchasing new hardware.

Physical consolidation using server virtualization is presented in Figure 7. In this scenario, selected targets are assumed to be underutilized with an average load of 1-10%. Half of the servers are assumed to be production servers, the rest of them are either development or test servers. In the current setup, each application is installed to a separate server to make systems as simple as possible. Therefore, hardware for six separate servers is required.

Using virtualization to perform consolidation, separate physical servers are replaced by a single server and software that enables virtualization. Each server is then replaced by a virtual machine. After virtualization is performed, each virtual machine can be administered, backed up and used as if it was an independent machine. The result of the process is that the number of physical servers has reduced. Transferring systems from old hardware to virtual machine has certain benefits even though obtaining new server hardware would be required. Having underutilized servers is avoided since the new hardware is shared, systems are transferred to a more standardized environment and the number of physical servers is reduced. The workload of migration to virtual machines and of replacing aged hardware is usually the same, since both operations contain similar tasks (e.g. transferring disk partitions). A shift to the virtualized environment is the most suitable solution in situations where changes to OS and application are not needed and virtualization as a technology is acceptable.

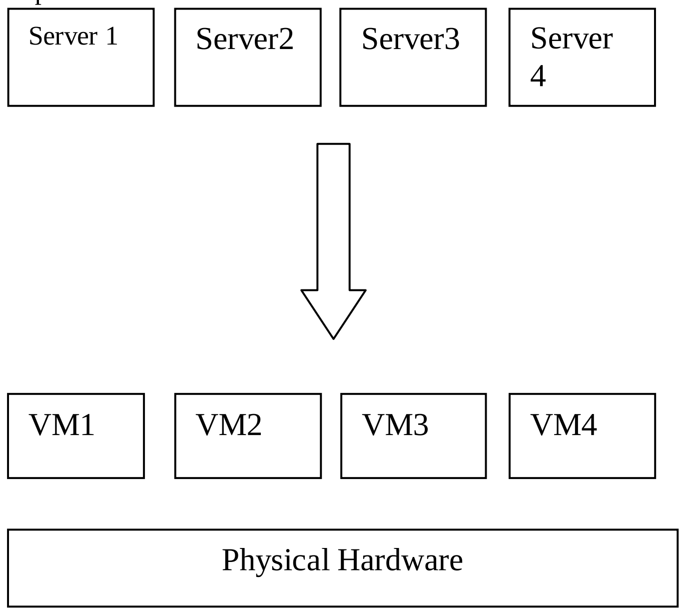

Fig 7- Physical Consolidation using Server Virtualization

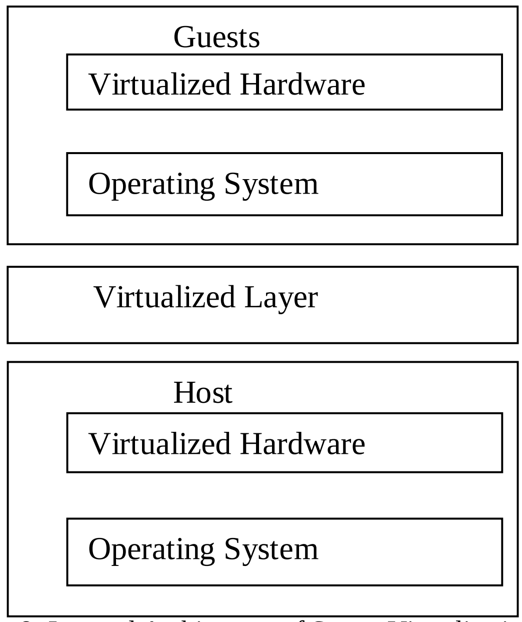

Fig 8- Layered Architecture of Server Virtualization

During planning, development and testing phases of a new system, a number of different environments are needed. While creating these environments requires hardware, the obtained hardware does not necessarily satisfy the requirements of the final production environment. If a separate production and development environment is needed, both environments also require separate hardware. In the production environment, performance is one of the main criteria while development and testing can be done in more modest environments. With virtualization, the entire environment can be built quickly by using virtual machines instead of separate physical machines. The solution is also cost effective since several virtual machines can run on a single server.

Server Virtualization can be divided into three separate layers:

- Host (Physical hardware and operating system)
- Virtualization Layer
- Guests (Virtual machines)

Figure 8 presents these three layers as a hierarchical model. At the lowest level, the host contains all procedures that are close to the hardware. On the top, the guest is fully implemented in software.

The host contains the physical hardware that is being virtualized and OS that is used to allocate hardware resources. The difference between a normal server and a host is in the use: the host focuses only on providing a virtual layer while the normal server is typically used to provide one or more services (e.g. e-mail and database).

The virtualization layer is created with virtualization software. The purpose of the virtualization layer is to share the host's hardware resources among guests. Therefore, virtualization does not change the hardware architecture that can be done with emulation. Besides resource sharing, the virtualization layer can also be used to provide other features such as isolation. Although the host's OS can provide isolation between processes and secure memory management, the isolation between guests is typically handled by the virtualization layer [16].

Guests are either virtual machines or virtual environments that can only see resources that are provided to them by the virtualization layer. The term virtual machine is used if all physical components of the hardware are virtualized and the guests and the host do not have to possess the same OS. The term virtual environment is used when the same OS is used in both host and guest systems. [21][16].

D. Different Virtualization Approaches

Normally all instructions issued by the OS are executed directly on hardware. If the hardware is shared among multiple operating systems, a portion of instructions may be required to be executed using the software instead of the hardware. The difference between hardware and software execution portions can be used to determine the VMM type. The following classification is typically used to create a distinction between emulation, real machine and different VMM types:

- Real machine. Everything is executed directly on hardware.
- Virtual Machine Monitor (VMM). A large part of instructions is executed directly on hardware. The rest of the instructions are executed on software.
- Hybrid Virtual Machine (HVM). All privileged instructions are emulated using software.
- Complete Software Interpreter Machine (CSIM). Software is being used to emulate every processor instruction [11].

Hardware virtualization can be provided in two different ways: by a replication of the host ISA or by modifying the guest OS. The replication of the host ISA provides full virtual environment, including basic Input/Output system (BIOS) that is used in hardware detection. The advantage of the ISA replication is that the guest OS sees shared resources as if they were physical devices. Modifying the guest OS consists of changing hardware specific calls to normal system calls and recompiling the OS. The result is a modified OS that can run as a normal process without the need of direct hardware access. Although only the kernel part of OS would require modification, obtaining the source code of the kernel and creating modifications are not always possible [8][3][20].

There are currently two vendors that use the ISA replication in commercial server virtualization products. The Server, on the other hand, uses hardware resources directly and it contains a minimal OS to start the virtualization. Microsoft Virtual Server uses the same approach as VMware Server. [26][13].

Modifying the kernel of OS is possible when the source code of the kernel is available. User-mode Linux and Plex86 are both based on this approach and their underlying principle is the same: A modified Linux kernel is used as a user process on a system that runs Linux kernel. Both User-mode Linux and Plex86 are being distributed as patches to normal Linux kernel. Although Linux kernel is available to a number of different ISA architectures, kernel modifications are only available to the IA-32 architecture. [8][22].

III. CONCLUSION & FUTURE WORK

. Virtualization is helping in the server consolidation and utilization. It also enables better security and reliability for applications using the same host. Virtualization also helps in disaster recovery and business continuity. The same can also be used in reducing IT departments' time in day to day administrative tasks helping in business needs. In this paper decoupling of Hardware and Software was presented. In future virtualization will maximize computer utilization and minimize the associated overheads of management, power consumption maintenance and physical space. In future architecture for optimization of resources and performance metrics using Server Virtualization of multiserver services can be explored.

REFERENCES

[1] Hewlett-Packard Company. HP Virtualization. 2003.

[2] International Business Machines. White paper: Partitioning for the IBM@server pSeries 690 System. October, 2001.

[3] Smith, J.E. An Overview of Virtual Machine Architectures October27, 2001

[4] Roach, Steven. Making the move to Windows Server 2003: Migration, Integration, & Consolidation (Part 2). Microsoft USA Presentations. May8,2003

[5] McIsaac, Kevin. Intel Server Consolidation: Part 1 – Virtualization. Meta Group. February 20, 2003.

[6] Cognizant Technology Solutions. SOS Solutions. Server Consolidation. 2002.

[7] Kozierok, Charles M. The PC Guide – System Resources April 17,2001

[8] Dike, Jeff. A user-mode port of the Linux kernel. 2000

[9] Intel Corporation. IA-32 Intel Architecture Software Developer’s Manual. Volume 1: Basic Architecture. 2003.

[10] International Business Machines, Server Consolidation with the IBM@server xSeries 440 and VMware ESX Server. November 2002. ISBN0738427330

[11] Robin, John Scott. Irvine, Cynthia. Analysis of the Intel Pentium’s Abilityto Support a Secure Virtual Machine Monitor. Proceedings of the 9thUSERNIX Security Symposium. August2000

[12] Dike, Jeff. User-mode Linux. 2001.

[13] VMware, Inc. VMware Server Products: Enterprise-Class Virtual Machine Software for Intel Servers. 2003.

[14] Intel Corporation. IA-32 Intel Architecture Software Developer’s Manual. Volume 2: Instruction Set Preference. 2003.

[15] Rosenblum, Mendel. Operating Systems and Systems Programming. Virtual Machine Monitors. 2003.

[16] VMware, Inc. Technical White Paper February, 1999.

[17] Sugerman, Jeremy. Venkitachalam, Ganesh. Lim, Beng-Hong. Virtualizing I/O Devices on VMware Workstation’s Hosted Virtual Machine Monitor.Proceedings of the 2001 USERNIX Annual Technical Conference. June 2001.

[18] Smith, J.E. ECE 902: Special Topics in Computers. Virtual Machine Architectures, Implementations, and Applications. Operating System VMs.[pdf-document]. October 1, 2001.

[19] Connectix Corporation. Virtual Server: Product Overview 2003

[20] Whitaker, Andrew. Shaw, Marianne. Gibble, Steven D. Denali: Lightweight Virtual Machines for Distributed and Networked Applications. University of Washington Technical Report. February 2, 2001

[21] SWsoft. Virtual Environments. 2003

[22] Lawton, Kevin. The Plex86 x86 Virtual Machine Project. 2003.

[23] Sun Microsystems Inc. White paper: Sun Fire [tm] 12K and 15K Servers High Availability Whitepaper in Data Center. February,2003.

