Resource Optimization of Servers Using Virtualization

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Abstract— In this paper a comparison of using multiple server services and how virtualization brings down the resource utilization. Server virtualization is the most important building block that enables application isolation, mobility, and partitioning of individual servers in the cloud. The physical servers have a virtual server layer above them which handles the resource utilization from varied clients. This extra layer brings down the resource utilization considerably.

Keywords— Virtualization, Servers, Multi Services Servers, etc

I. INTRODUCTION

Virtualization is the process of decoupling the hardware from the operating system on a physical machine. It changes, what used to be considered purely hardware earlier into a software implementation. Put simply, you can think of virtualization as essentially a computer within a computer, implemented in software. 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. The main idea of virtualization is to provide computing resources as 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.
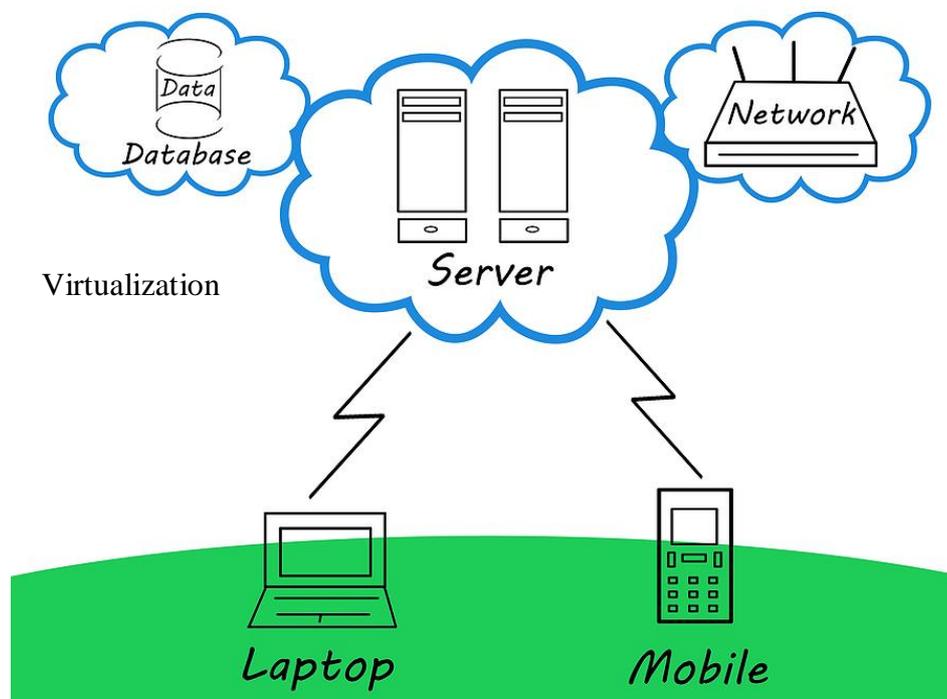

Fig 1 – Server in a Virtualized Environment.

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 technology available. For example, Computer Memory Virtualization is 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 [3] [6] Figures 2 and Figure 2 illustrate the difference between physical servers and virtual servers. Figure 2 presents four servers where each server has its own processor memory, local disk and network connection. Figure 3 presents virtual machines and a Virtualization Layer.
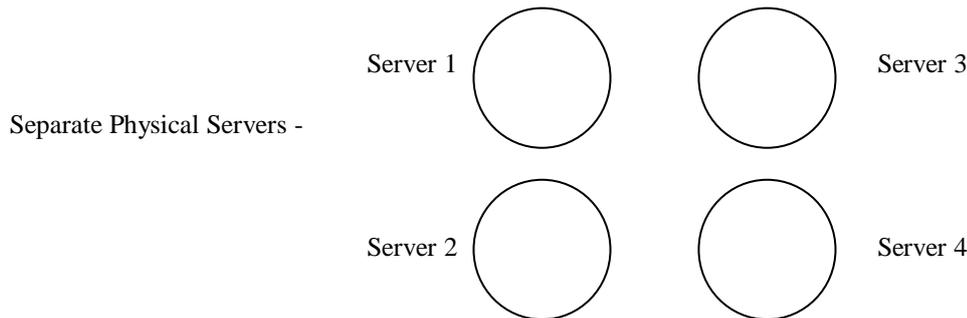
Separate Physical Servers -

Server 1

Server 3

Server 2

Server 4

Fig. 2 – Physical Servers

Virtual Machine1
Server 1

Virtual Machine2
Server 2

Virtual Machine3
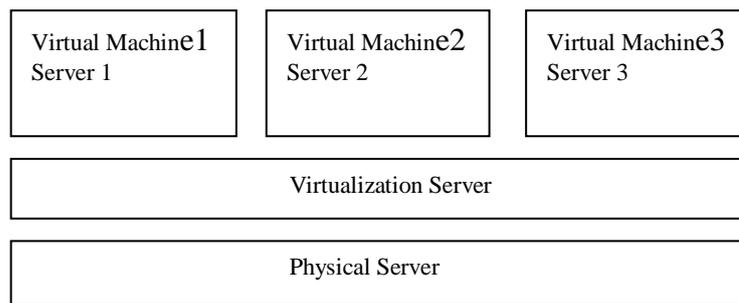Server 3

Virtualization Server

Physical Server

Fig 3 - Presents Virtual Machines (VMs) 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. PROPOSED WORK
Working of Virtualization as Multiple Server
Here three Operating Systems are considered. All the Virtual OSs are working as servers by providing different server services. The utilization of resources and memory usages of Virtual OS with comparison between graphs is done. When OS work with other OSs the comparison is represented with help of graphs. With the help of virtualization a single physical machine is bifurcated into following three operating systems

- Window XP
- Windows Server 2003
- Ubuntu Linux

The above three virtual operating systems are providing different virtual services. The resource usage and the memory utilization are different for each of the kind of the Operating System.

III. IMPLEMENTATION & RESULTS

Following are the three examples which were populated to observe the impact on CPU usage and the memory utilization:

- Windows XP working as the FTP server which provides the client system File transfer services.
- Windows Server 2003 working as the HTTP server providing the web based services.
- Ubuntu Linux working as the RIS server which is used for installing the Operating System on any client machines.

TABLE 1
POPULATES THE RESOURCE USAGE AND MEMORY UTILIZATION

SL. No.	Scenario	CPU Usage (%)	Memory Utilization (%)
1	Windows XP	17.1	52.2
2	Windows Server 2003	34.2	55.2
3	Ubuntu Linux	13.5	56.2
4	Window XP & Window Server 2003	20.5	76.2
5	Window XP & Ubuntu Linux	29.5	77.2
6	Window Server 2003 & Ubuntu Linux	18.1	71.2
7	Window XP, Window Server 2003 & Ubuntu Linux	72.4	65.6

The above table shows the Resource usage for all the servers separately as well as after implementing one of them as a virtual machine. We find that CPU usage as well Memory Utilization increases as we start increasing the virtualization or adding separate virtual servers. Most important point to be noted here is that Memory Utilization gets decreased when I successfully implemented the virtualization, and thus optimizing the resource usage.

Now suppose we are not using Virtualization, and have the three operating systems running on three different servers. CPU configuration used for the implementation –

- No of Cores – 2
- Processor Speed – 2.8GHz
- RAM – 1GB

Using this configuration for

- Windows XP (at the instance when table was made) we can say that it is using 52.2% of 1024 MB i.e. 534 MB.
- Windows Server 2003 is using 55.2% of 1024 MB i.e. 565 MB
- Ubuntu is using 56.2% of 1024 MB i.e. 575 MB

Total resource utilization comes out to be 1674 MB.

Now after implementing Virtualization using Virtual Box all three systems are using 65.5% of 1024 MB which is 671 MB, which is conclusively less than the total resource utilization for each operating system successfully. Similarly adding the CPU usage we find out that after virtualization total CPU usage has increased by 6%, which can be accounted for the extra implementation of Virtualization running on Ubuntu Operating System. Figure on the next page shows the CPU usage and memory usage graph when virtualization has been implemented for all three operating systems. This image represents the scenario 7 whose values at a particular instance are presented in Table 1.

IV. CONCLUSION AND FUTURE WORK

I was successfully able to optimize the resource utilization as shown in Table 1. Using Ubuntu as an RIS server optimized the resource usage as Linux is usually a very robust system. Virtualization helped in server consolidation and utilization. It also enabled better security and reliability for applications using the same host. Virtualization also helped in disaster recovery and business continuity. The same can also be used in reducing IT departments' time in day to day administrative tasks. In future, I would suggest to, continue the experiment with new versions of Ubuntu. I feel that one can also look into changing the roles of different operating systems like using Windows XP as a RIS server, Ubuntu as the FTP server. This way we can also compare the results as to which combination brings down the resource utilization and what is the minimum level that one has achieved. In general, virtualization has maximized computer utilization and decreased the associated overheads of management, power consumption maintenance and physical space. The below given Figure 4 shows the results for Point No 7 presented in Table 1.
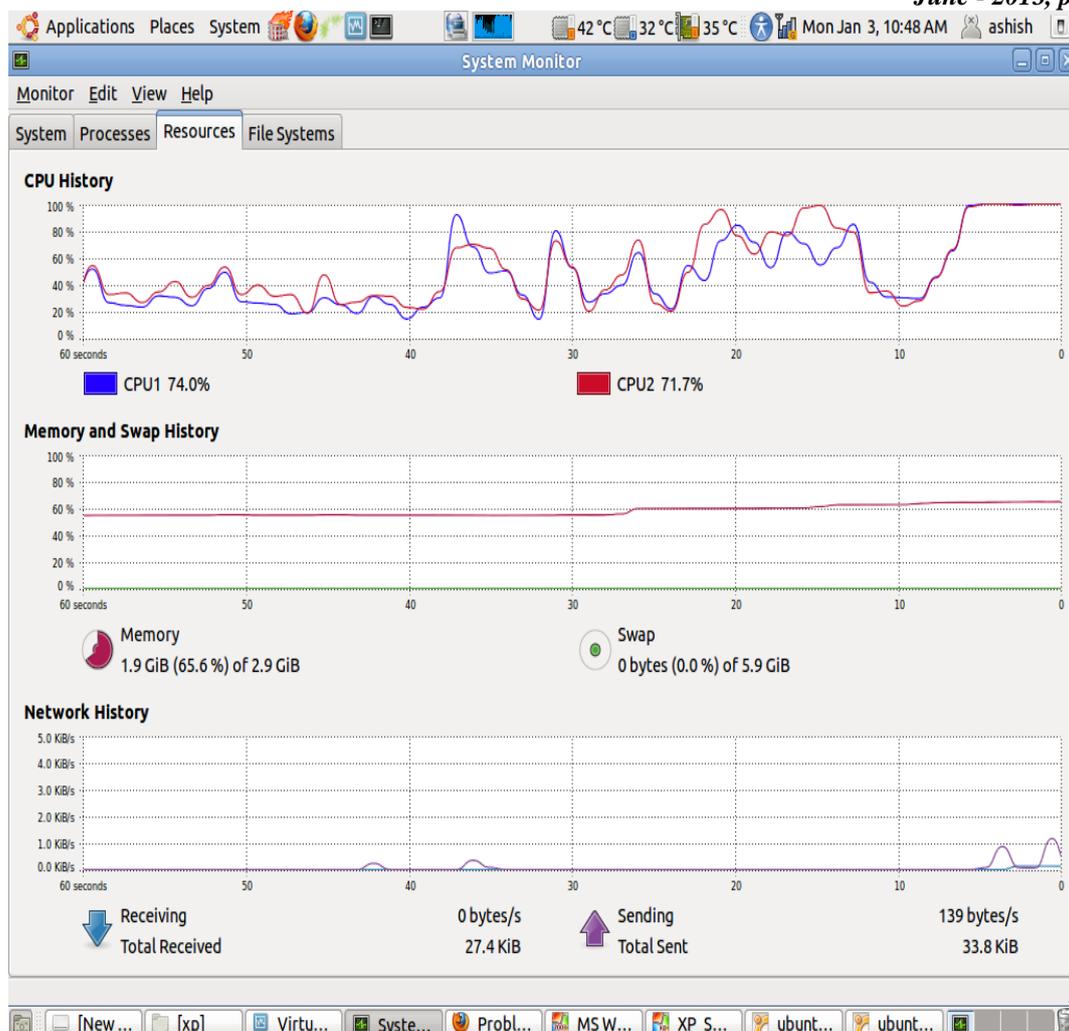
Fig 4 Resource Utilization

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