



Comparison between VMWare and Oracle VirtualBox Virtualization Technologies

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ABSTRACT

The main purpose of this paper is to compare the performance of the Oracle VirtualBox and VMWare virtualization technologies. The study focuses on the performance of disk I/O, memory and CPU operations under virtualization infrastructures. This performance is measured by benchmarking tools like Iozone for disk I/O performance, RAMspeed for memory performance and UnixBench for CPU performance. Results of benchmarking tools will identify which technology is better than other and in what respect.

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Introduction

Definition of Virtualization

Virtualization is often used when we want to do something that is not possible in reality, or something which we do not have the necessary equipment for[11]. Most people are familiar with Virtual Reality, where an environment gets simulated on a computer, often for visual experiences.

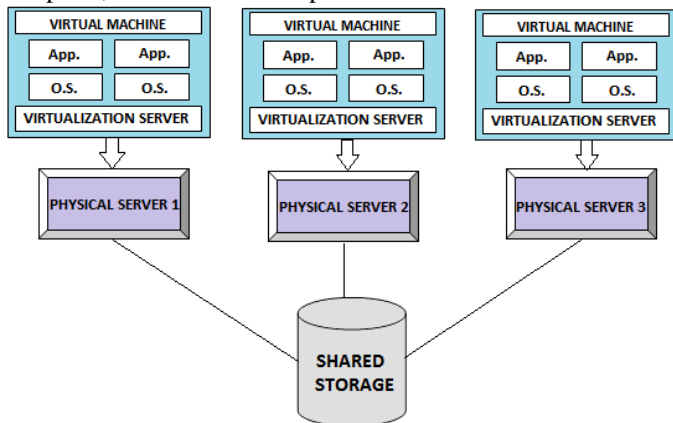


Figure 1: Concept of Virtualization

Virtualization Technology

1) VMWare Virtualization Technology

VMware is the most popular and the most leading technology for resource management[5]. VMWare also provide reliability to virtual machines even more than running directly on hardware. VMWare new researches are developing day by day that includes the Virtual Networking, high-speed I/O and Security in the Cloud, storage, Virtual Machine File System, and Scalable Virtual Machine Storage using Local Disks. VMWare always focused on reducing the performance overheads[13].

2) Oracle VirtualBox Virtualization Technology

VirtualBox is a cross-platform virtualization application. It installs on computers, whether they are running Windows, Mac, Linux or Solaris operating systems[4]. It also extends the capabilities of existing computer so that it can run multiple operating systems (inside multiple virtual machines) at the same time. For example, we can run Windows and Linux on Mac, run

Windows Server 2008 on Linux server, run Linux on Windows PC, and so on, all alongside our existing applications. We can install and run as many virtual machines as we like; the only practical limits are disk space and memory[2].

Literature Review

According to (Balsa, 1997), the main criticism of synthetic benchmarks is that they do not represent performance of real-world situations. For instance, the Whetstone suite's main loop is very short and easily fits in the primary cache of a CPU, keeping the CPU queue filled and testing it to its full capability. The interpretation of synthetic benchmarking results must therefore be done very carefully when testing modern CPUs.

According to (Balsa, 1997), synthetic benchmarks should test the performance of hardware components in isolation. They give the example of benchmarking Ethernet card I/O on various hardware configurations and states that the results should be relatively similar.

Virtual machine monitors for the purpose of performance comparison is extensively studied by different researchers. VMWare performance is measured by Barham et al. (2005) where they compare VMWare with Xen. KVM and Xen performance comparison was made by Deshane et al He compares the performance, isolation and scalability with CPU, kernel compile and Iozone tests.

According to Casazza et al.(2006). There are also some overhead of virtualization technology. These overheads are listed below:

- The reported time by guest OS can be incorrect.
- In-identical configuration can be caused incorrect information.
- Resource contention with other Virtual Machines.
- Consistency of results .Some approaches consider several factors that increase the overhead."

According to Fuertes and Vergara (2007) consider that[3] "particular virtualization technology may have different overhead as compared to others because of their different architecture. Different hardware resources may also cause to affect the virtualization performance. One VM overload can also be caused to have extra overhead for other VMs in the system"

According to Boss et al. (2007) "Enterprises have been striving to reduce computing costs and for that reason most of them start consolidating their IT operations and later using virtualization technologies. For the good of the enterprises there is a new technology to help them in this i.e. Cloud Computing. Cloud computing claims to take enterprises search to a new level and allow them to further reduce costs through improved utilization, reduced administration and infrastructure cost and faster deployment cycles."

According to Naveed Yaqub (2012)[9], while testing the memory performance with ram speed with block size smaller than 4 MB, KVM perform 4 to 7% better than VMWare. In case of block size larger than 4 MB, VMWare perform 15 to 25% better than KVM. In case of other writing VMWare observed 30 to 50% better than KVM. CPU performance was measured by using UnixBench. The performance of VMWare was quite close to the performance of Bare Metal. In case of ALU bound processes, no overhead was observed and performance of KVM and VMWare was almost similar to Bare Metal. In UnixBench composite throughput score, Bare Metal performs 9% better than VMWare and 29% better than KVM. Whereas VMWare perform 20% better than KVM. In overall performance, the VMWare perform better than KVM. In some cases VMWare performs twice better than KVM. Whereas. In few cases KVM also gave better results than VMWare

Xu et al. benchmarked Xen, KVM and VMWare, and tested the overall performance, isolated performance and scalability of the VMs. The benchmark was performed on an Intel Core 2 processor with CentOS 5.1 with kernel 2.6.24, on which Xen 3.2, KVM-62 and VMWare Workstation 5.5 was tested. The benchmarks tested the performance of the CPU and memory using UnixBench, of which Xen performed the best.

Fenn et al. represent a performance study of how KVM would perform in a Virtual Organization Cluster for grid computing. Fenn et al. used a 16 node physical cluster on which they ran CentOS that in turn was chosen as the OS for their virtual compute nodes. The main focus of the work was to see how KVM would act as a hypervisor in a virtual cluster. In addition to KVM the authors tested performance on Xen and of course physical nodes. KVM version used was KVM-77, and the benchmarking suite used was the Linpack benchmark.

Problem Formulation

Problem Statement

"This paper will study the virtualization technology i.e. VMWare and Oracle VirtualBox on the basis of performance comparison. The performance comparison of these technologies will be done by different benchmarking tools with respect to CPU, Disk I/O, and memory. This paper primary focused on comparison of Oracle VirtualBox and VMWare virtualization technologies"

Benchmarking Overview and Tools

1) Benchmarking

Benchmarking is a computerized test for measuring the properties of the particular technology. These properties can be speed, performance, transfer rate, etc.[15].

2) Iozone I/O Benchmark Tool

Iozone is a file system benchmark tool. Iozone is written by Norcott, with enhancements by Capps[10]. It is an analyzed file systems. It measures a variety of file operations. Iozone has been ported to many machines and runs under many operating systems. Iozone uses a lot of different operations for testing[16].

3) RAMspeed memory Benchmark Tool

RAMSMP is tool which is used to benchmark cache and memory. It determines the bandwidth of a system's various memory components. It is written in C language[15].

RAMspeed is a free open source command line utility to measure cache and memory performance of computer systems[1]. Its first version v1.00 was released in November of 2002 as a result of Rhett's personal amusement containing about 100 lines of C code to produce one simple benchmark. Latest versions of RAMspeed are mostly written in assembly language[13].

4) UnixBench CPU Benchmark Tool

UnixBench is an open source tool. It was first started in 1983 at Monash University. It provides performance of UNIX systems in various aspects of system performance specifically for CPU .UnixBench produces the results as an index values after comparing the test results with baseline system. The reason for producing the indexed results is, to make discussion easy for analysis point of view. It also produces the overall index after combining the entire set of index values[1].

Implementation

In this research work we have taken two systems. In both systems we have installed Ubuntu 12.04 as a host operating system. In one system we have installed VMWare workshop and in another system we have installed Oracle VirtualBox. In the virtual environment we use Ubuntu as guest operating system.

Implementation of Iozone Test

Iozone will be used to test the I/O performance. Iozone is known tool for disk I/O operations benchmarking and provides the various useful results to determine the I/O of the disk[4]. We have test the Iozone tool for different file sizes like 1 MB, 64 MB, 128 MB, 256 MB, 512 MB and we have found different results at different file size. Single run of Iozone is like (where -s indicates file size):

```
$iozone -s 512Mb -r 4k
```

Implementation of RAMspeed Test

RAMspeed provides different options to test the different memory level in the system. We have run this test for integer writing and reading, float writing and reading. In this test -b indicate specific benchmark like -b1 is for write integer, -b2 is for read integer, -b4 is for float write, -b5 is for float read[6]. Single run of this command is like:

```
$/ramspeed -b1
```

Implementation of UnixBench Test

This test is quite easy to implement. We have to type just Run to execute this test[12]. Run of this test is like:

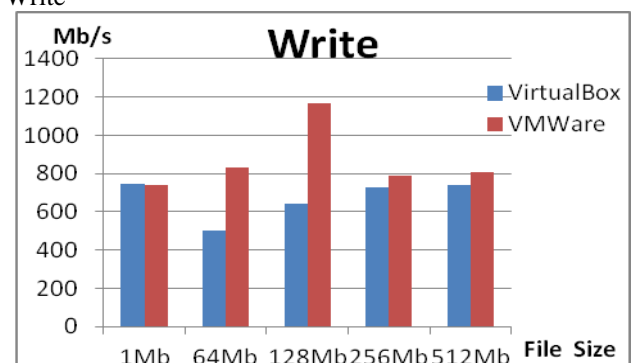
```
$/Run
```

Results and Discussions

A. Iozone

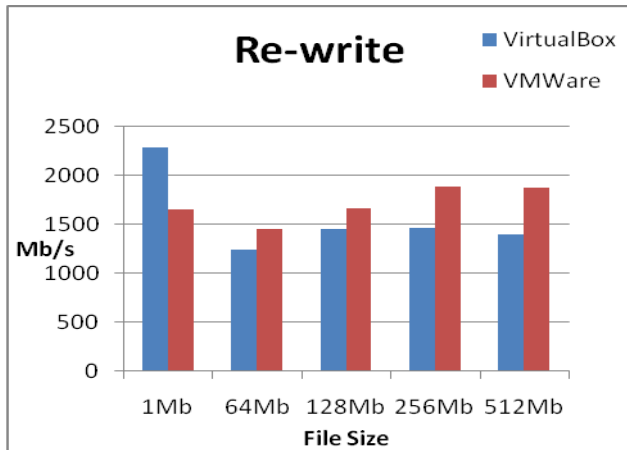
In Iozone we have different graphs according to different file operations.

1) Write



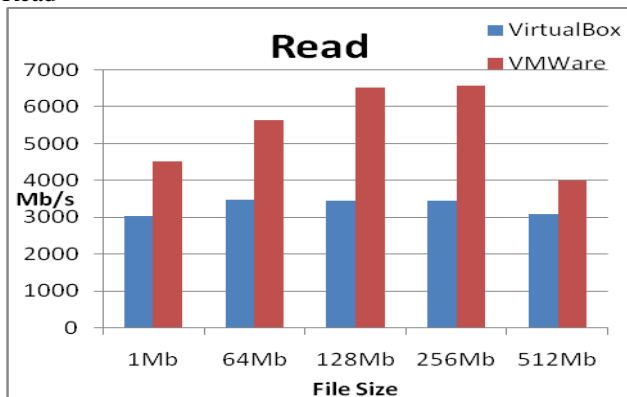
The performance of Iozone with writing was illustrated in this graph. In this graph performance of VMWare is on top while comparing VirtualBox and VMWare.

2) Re-write



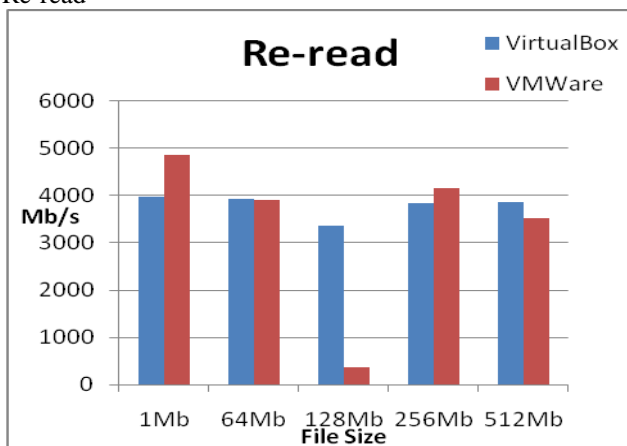
The performance of Iozone with re-writing was illustrated in this graph. In this graph at small file size VirtualBox give best performance but when file size increases then VMWare gives best performance.

3) Read



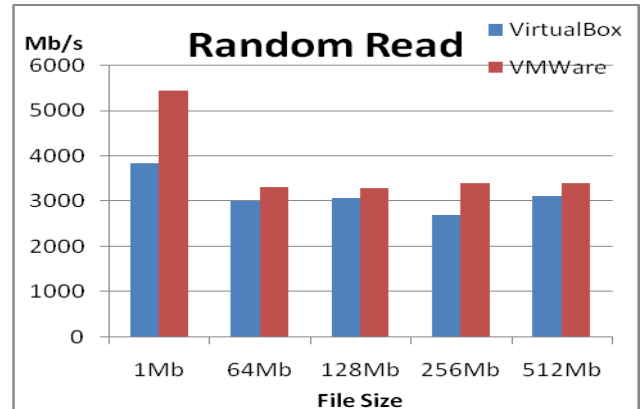
The performance of Iozone with reading was illustrated in this graph. In this graph performance of VirtualBox is almost same at different file size, Whereas VMWare performance is on top at every file size.

4) Re-read



The performance of Iozone with re-reading was illustrated in this graph. In this graph we see different variations. At file size 1Mb VMWare is best, whereas at file size 512Mb VirtualBox is best. The main point of observation is here at 128Mb, where VirtualBox is on the top.

5) Random read



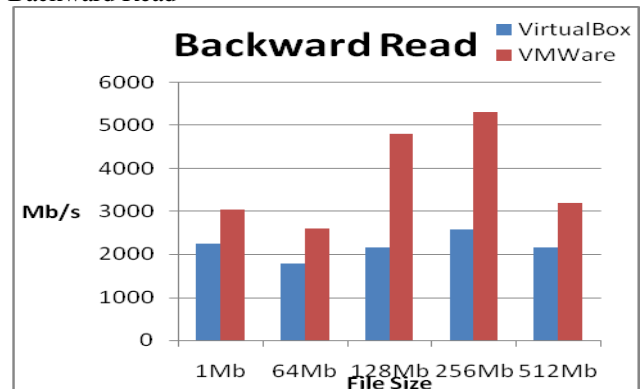
The performance of Iozone with Random Read was illustrated in this graph. In this graph overall performance of VMWare is best as compare to VirtualBox.

6) Random write



The performance of Iozone with Random Write was illustrated in this graph. In this graph overall performance of VMWare is best as compare to VirtualBox.

7) Backward Read



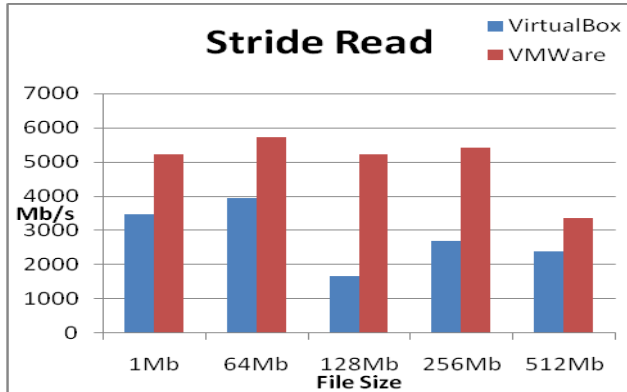
The performance of Iozone with Backward Read was illustrated in this graph. In this graph overall performance of VMWare is best as compare to VirtualBox.

8) Record Rewrite



The performance of Iozone with Record Rewrite was illustrated in this graph. In this graph we see different variations. At small file size like 1Mb and 64Mb VirtualBox is good but when the file size increases then VMWare is best.

9) Stride Read



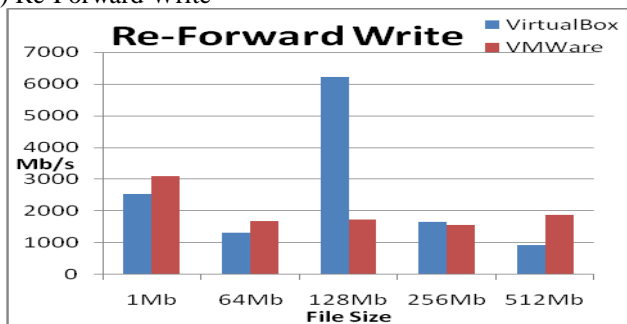
The performance of Iozone with Stride Read was illustrated in this graph. In this graph overall performance of VMWare is best as compare to VirtualBox.

10) Forward Write



The performance of Iozone with Forward Write was illustrated in this graph. In this graph overall performance of VMWare is best as compare to VirtualBox.

11) Re-Forward Write



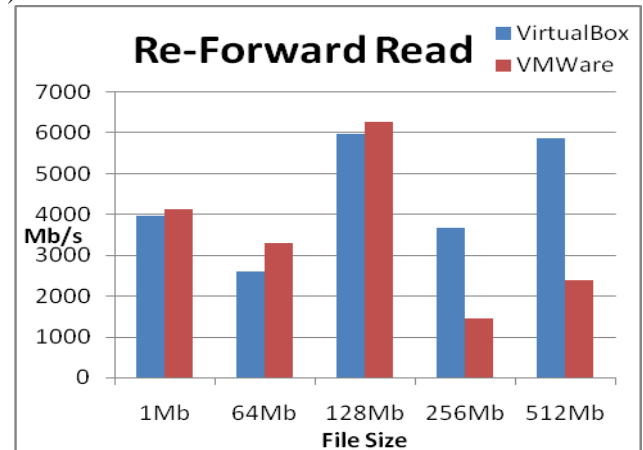
The performance of Iozone with Re-Forward Write was illustrated in this graph. In this graph we have observed different variations. At file size 1Mb, 64Mb and 512Mb VMWare is good. But in middle size like 128 Mb VirtualBox is on the top.

12) Forward Read



The performance of Iozone with Forward Read was illustrated in this graph. In this graph at file size 1Mb, 64Mb, 128Mb, 256Mb VMWare is best whereas at 512Mb VirtualBox is best.

13) Re-Forward Read



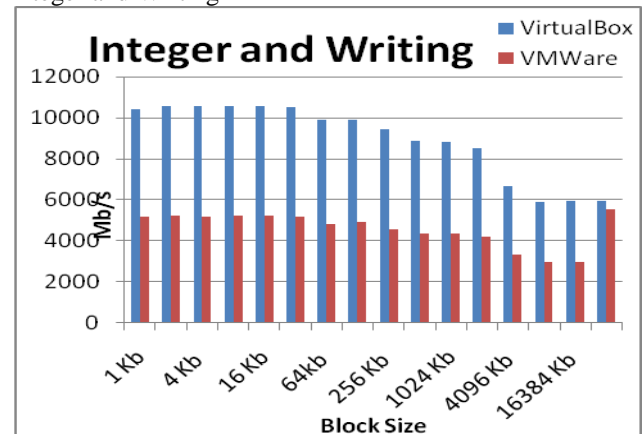
The performance of Iozone with Re-Forward Read was illustrated in this graph. In this graph at small file size like 1Mb, 64Mb and 128 Mb VMWare is best whereas at large size like 256Mb and 512Mb VirtualBox is best.

So we can say overall VMWare is best as compare to VirtualBox while doing Iozone test.

B. RAMspeed

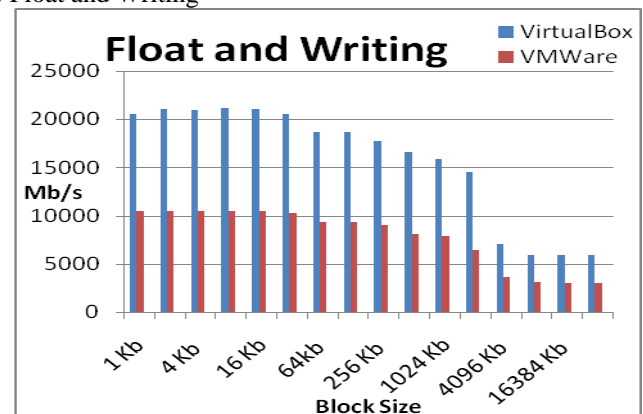
We have tested RAMspeed test for integer read, integer write, float read and float write.

1) Integer and Writing



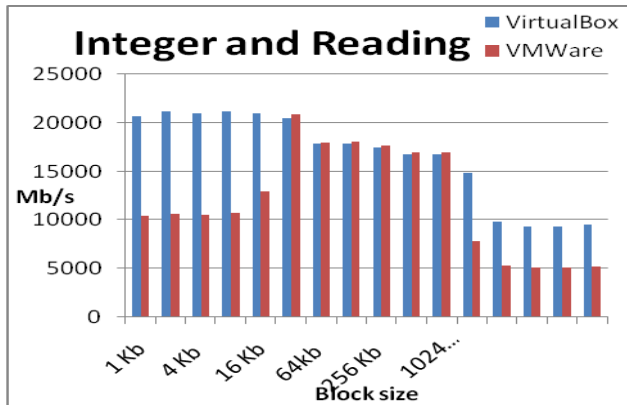
The performance of RAMspeed with Integer writing was illustrated in this graph. In this graph we have observed that starting from 1kb to 16384kb VirtualBox is best but at the last block size 32768kb VMWare is good.

2) Float and Writing



The performance of RAMspeed with float writing was illustrated in this graph. In this graph all over VirtualBox is best as compare to VMWare.

3) Integer and Reading



gaining popularity whereas VMWare virtualization is the market leader. Most of the organizations are using VMWare.

The primary purpose of this report is to make the comparison between Oracle VirtualBox and VMWare. Oracle VirtualBox and VMWare are both different technologies of virtualization with different architectures. Oracle VirtualBox uses Paravirtualization approach whereas the VMWare uses the hardware layer virtualization approach. So with different architecture of these technologies, performance may vary with different parameters (CPU, Disk I/O, and memory).

While comparing VMWare with Oracle VirtualBox with the help of benchmarking tools, we have observed that performance of each software vary with different test. In iozone test overall performance of VMWare is best as compare to Oracle VirtualBox. But we cannot avoid those results where VirtualBox gives better results than VMWare. In re-forward write test of iozone VirtualBox perform twice better performance than VMWare. While doing RAMspeed test in integer write, float write, float read VirtualBox is best, but in integer read we observed interesting result. In integer read at small and maximum block size VirtualBox is good but at middle block size VMWare shows better performance than VirtualBox. In UnixBench test Oracle VirtualBox gives 57 percent performance whereas VMWare gives 43 percent performance. So overall VirtualBox is better than VMWare while doing UnixBench test.

In overall performance, the VirtualBox perform better than VMWare, but in some cases VMWare perform twice better result than VirtualBox.

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