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A SURVEY OF BENCHMARKING OF HYPERVISOR

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Abstract-Virtualization means creating the virtual resource like a server, desktop, operating system, file storage or network. By the functionality of virtualization it is possible that we can run one or more virtual computer on single hardware. Virtualization is widely used for the Storage virtualization, Network virtualization, Server virtualization, Application virtualization.This virtualization is carried out by the software layer called as the Hypervisor or Virtual Machine Monitor (VMM). Hypervisor abstract the underlying hardware from the operating systems running on it, so simultaneously multiple operating system can be made run on same hardware resource. There exists various type of hypervisors like open source Hypervisors and commercial Hypervisors. In the area like Distributed Database, Parallel computing and Cloud computing Hypervisor is widely used. Our target hypervisors are Microsoft Hyper-V server and Xen Hypervisors. These all hypervisors are come into category called as Bare-metals Hypervisors. The Bare metal Hypervisors have the direct access to the hardware resource rather than accessing resource via operating system. Benchmark is the measurement of best practice performance. Benchmarking is very essential term for the discovery of the best performance given by the particular system. Benchmarking can provides you the external references and the best practices on which to base your evaluations and to design your system processes which can be very useful in finding the gaps in the system to achieve the desired performance.

Keywords- Benchmarking, Hypervisors

I. INTRODUCTION

We considered different research papers related to the benchmarking the performance of the hypervisors and we studied how they carried out there experiment and how they benchmarking is done. Firstly we have to concern about the virtualization and its needs. Virtualization means creating the virtual resource like a server, desktop, operating system, file storage or network. By the functionality of virtualization it is possible that we can run one or more virtual computer on single hardware. Virtualization is widely used for the Storage virtualization, Network virtualization, Server virtualization, Application virtualization.

1. Virtualization:

Virtualization is nothing but technology which makes abstraction of computing resources such as hardware, storage, networks. Virtualization is nothing but create multiple logical instances of either software or hardware with abstraction of underlying resources. Now a day's virtualization has become the base technology for the cloud computing. Virtualization is the technology that can allows the creation of various computing environment. These computing environment are usually called as the virtual, as they are simulating the interface that is expected by guest [1].

1.2. Benifits of Virtualization:

1. Save money.
2. Save energy.
3. Save time.
4. Increase Performance.
5. Increase computing capacity

1.3. Hardware-assisted virtualization, Full and Para-virtualization.

Hardware-assisted virtualization in this scenario the hardware provides architectural support for building VMM (Virtual Machine Manager) which can able to run the Guest operating system in total isolation [1][3].

Full virtualization is the ability of running programs most likely as an operating system directly on the top of VM prior to any modification just like it is running on the raw hardware to make this possible entire underlying hardware must be emulated to VMM [1][3].

Para-Virtualization partial emulation of underlying hardware is provided to the VMM thus the guest operating system is not executed in complete isolation. Para-virtualization can run many applications transparently but not all that features are provided those are provided in full virtualization [1][3].

II. LITERATURE SURVEY

1. Hypervisor

This virtualization is carried out by the software layer called as the Hypervisor or Virtual Machine Monitor (VMM). Hypervisor abstract the underlying hardware from the operating systems running on it, so simultaneously multiple operating system can be made run on same hardware resource. There exists various type of hypervisors like open source Hypervisors and commercial Hypervisors. In the area like Distributed Database, Parallel computing and Cloud computing Hypervisor is widely used [2].

1.1. Native / Bare Metal Hypervisor

This type of hypervisor runs directly on the top of the underlying resource or hardware. Therefore Native hypervisors have direct access of hardware rather than accessed it through the operating system. This hypervisor interact directly with the ISA (Instruction Set Architecture) interface exposed by the underlying hardware and emulate this interface in order to allow the management of guest operating system. These types of hypervisors are called as native hypervisors as they run natively on the underlying hardware [1][3.0].

1.2. Hosted Hypervisor

The Hosted Hypervisors have access to the hardware via conventional operating system. They require the support of the operating system to provide the virtualization services.

This means that they are the programs managed by the operating systems, which interact with it through ABI (Application Binary Interface), and emulate the ISA of the virtual hardware for guest operating system. These type of hypervisors are called as hosted as they are hosted by operating system [1][3.0].

1.3. Microsoft Hyper-V server and Xen hypervisor

The Microsoft Hyper-V server and Xen Hypervisor fall under the Micro-kernalised Hypervisors family, while the VMware ESXi falls under the Monolithic Hypervisors family. The Microsoft Hyper-V server and Xen Hypervisor of the Micro-kernalised Hypervisors family produce the Para-virtualization approach along with the Full-virtualization approach. Para-virtualization approach is a virtualization approach that presents a software interface to virtual machines that is similar, but not identical to that of the underlying hardware

1.3.1. Microsoft Hyper-V

Microsoft Hyper-V server is hypervisor based virtualization technology for x86 version of windows server The Hyper–V architecture is based on Micro-kernalised hypervisors. MS Hyper-V implements isolation of virtual machine in terms of partition (operating system and applications) A hypervisor instance has to have at least one parent partition, running supported version of Windows Server.

1.3.2. Xen hypervisor:

Xen Hypervisor solution is originally developed at the University of Cambridge. It is the only bare metal hypervisor which is available as open source. Xen Hypervisor is lightweight because it can delegate management of guest domain (DomU) to privileged domain (Dom0)

Xen hypervisors are useful for CPU schedules and Memory partitioning of various virtual machines running on hardware device. Dom0 is a unique virtual machine running on Xen Hypervisors that has special right to access physical I/O as well as interact with other virtual machines. While DomU have no direct access to physical hardware

III. BENCHMARKING THE HYPERVISORS

Benchmark is the measurement of best practice performance. Benchmarking is very essential term for the discovery of the best performance given by the particular system. Benchmarking can provides you the external references and the best practices on which to base your evaluations and to design your system processes which can be very useful in finding the gaps in the system to achieve the desired performance.

Benchmarking Advantages:

1. Measurement of the best performance.
2. Comparison of performance.
3. Provides external References of performance.

The papers we have studied about the benchmarking the performance of hypervisors are contain the performance comparison of different hypervisors on different Benchmark.

IV. CASE STUDIES

1. Benchmarking performance of Microsoft Hyper-v, VMware ESXi and Xen Hypervisors [2].

1.1 Testing Background

They use the Non-virtualized Machine; it is called as the bare machine. For the Hyper-V and Xen Hypervisor two virtual machines are created these are Para-virtualization and Full virtualization. Linux PREEMPT-RT v3.8.4-rt2 is used as guest OS Being an open source and Hardware assisted (HW-assisted) virtualization approach is used instead of Full Configurable for usage in Para-virtualized VM are the main reasons for selecting it as the guest OS.

1.2. Testing

The Time Stamp Counter (TSC) is used for obtaining (tracing) the measurement values. It is a 64-bit register present on all x86 processors. The instruction RDTSC is used to return the TSC value. Note that the tests are initially done on a non-virtualized machine called as bare machine for preferences Two tests are carried out as below:

1. Clock tick Processing Duration
2. Thread Switch Latency between Threads of Same Priority

1.3: Results

Maximum clock tick processing duration	
Bare-Machine	10 µs
Hyper-V HW-Assisted VM	4.35 ms
Hyper-V Para-virtualized VM	1.62 ms
Xen HW-Assisted VM	35 µs
Xen Para-virtualized VM	23 µs
ESXi HW-Assisted VM	59.61 ms

Maximum thread switch latency between:		
	2 Threads	1000 Threads
Bare-Machine	11.2 µs	11.45 µs
Hyper-V HW-Assisted VM	63 µs	135 µs
Hyper-V Para-virtualized VM	45 µs	106 µs
Xen HW-Assisted VM	27.3 µs	27.4 µs
Xen Para-virtualized VM	15.27 µs	17.2 µs
ESXi HW-Assisted VM	19.28 µs	25.7 µs

Fig.1: Result of Case study 1

1. Para virtualization approach in the MS Hyper-V will be the corresponding HW assisted by two factors better method than that and this is a factor of 1.5 Xen.
2. Xen Para virtualized performance than the MS Hyper-V in a much better.
3. The Xen performance (for Para virtualization and HW-secondary) is very close to the bare machine (non-virtualized hardware), which makes Xen candidate for soft real-time operating system

2. Virtual Machine Performance Benchmarking [3]

2.1. Testing Background

The measurement hardware consisted of two identical Dell 690 workstations: 1 Gbit network interface, 8 GB of RAM, 15,000 RPM SCSI disks, and a 2.3-GHz quad core processor For the file server, we chose FreeNAS Version 7 which is an optimized open source file server appliance based on 64-bit FreeBSD. The two computers shared a private Gbit switch

The virtualization products trialed included:

a) VMware Player 7 (VM Ware Inc., Palo Alto CA)
b) VMware ESXi Server V 4.0 (VM Ware op cit)
c) Sun Virtual Box V3.1.2 (Sun Microsystems, op cit).
d) Red Hat KVM V5.4 (Red Hat op cit)
e) Xen (Citrix Systems, Fort Lauderdale, FL).

2.2. Testing

To standardize the measurement procedure, we built a suite of measurement tools on top of a minimalist instantiation of

Red Hat V5.5 32 bit. A 32-bit VM was chosen as the benchmark platform for portability, a 32-bit VM can run on either a 32- or 64-bit host OS. Using this base "appliance," They crafted a suite of tests that measures.

1. RAM Performance.
2. Local Disk Performance.
3. Network Performance.
4. Web Read Performance.
5. CPU Integer Performance.
6. CPU Float Performance.

2.3. Result

1. For various reasons we have found it very productive to adopt virtualization in our practice
2. Read performance on local and network disk is negatively impacted as is floating point performance.

3.The best performance was often seen from a thick virtualization tool (Virtual Box) rather than the thin hypervisor environment

3. Performance Evaluation of Hypervisors in the Private Cloud based on System Information using SIGAR Framework. [4]

3.1. Testing Background

The experimental design contains private cloud infrastructure created using CloudStack. CloudStack is an Infrastructure as a service (IaaS) cloud based software which builds

In the experiment, Management Server (a Virtual Machine with hardware configuration of 4GB RAM and 100GB hard disk) is installed on Ubuntu (12.04 64-bit) operating system. Second machine is the host machine where hypervisors are installed on a bare metal with hardware configuration of AMD FX 8150 – 8 Core 3.6 GHz processor, 32 GB RAM, 1 TB hard disk and 2 NICs for the test environment. In our test environment XenServer 6.0, ESXi 4.1 and KVM (Ubuntu 12.04) hypervisors are deployed as hosts and virtual machine (VM1- Windows 2008 R2) is installed on all three hypervisors.

3.2 Testing

After the Windows VM is installed on all three hypervisors, CPU, Memory, Disk I/O and Network performances are measured using SIGAR Framework. SIGAR (System Information Gatherer and Reporter) is a platform independent tool for accessing system level information in Java and other programming languages. In the experiment, Java program has written to gather system information using SIGAR API by deploying sigar-amd64-winnt.dll for Windows.

3.3 Result

Native performance is normalized at 1.0 and all other various benchmark results are shown relative to that number. Higher numbers indicate better performance of the particular virtualization platform, unless indicated otherwise. Near-native performance also indicates that more virtual machines can be deployed on a single physical server, resulting in higher consolidation ratios

	Available CPU (%)		Available Memory (%)
Native	97	Native	77
ESXi 4.1	97	ESXi 4.1	75.23
Xen 6.0	96.5	Xen 6.0	64.23
KVM(Ubuntu 12.04)	93.5	KVM(Ubuntu 12.04)	58.52
Native	1	Native	1
ESXi 4.1	1	ESXi 4.1	0.97
Xen 6.0	0.99	Xen 6.0	0.83
KVM(Ubuntu 12.04)	0.96	KVM(Ubuntu 12.04)	0.76

Fig.2: Result of case study 3

ESXi exhibits better performance compares to other hypervisors, hence it is most recommended hypervisor.

V. CONCLUSION

We focused on study of Virtualization, Hypervisor and Benchmarking. We have studied different paper related to benchmarking different hypervisor performance. From the above case studies we can conclude that Performance of hypervisors under different condition may vary. The considered case studies in the report are different research papers regarding the benchmarking the performance of the hypervisors. In research papers author carried out comparisons among different hypervisors based on the different criteria, The performance of different hypervisors may get influenced by the environment and the resources.

Further study can be carried out in discovering the new benchmarking techniques for benchmarking the hypervisors.

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