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Research Article

Performance analysis of hypervisor based on energy efficiency

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ABSTRACT

Cloud computing has become one of the inevitable technology in the current situation. This technology made the possibility of creating more work areas using a single machine the concept of virtualization. Virtualization is a cloud-computing technology that only needs one CPU to work. Virtualization makes it look like many devices are working together. Virtualization focuses mainly on efficiency and performance-related tasks because it saves time. This paper will compare the performance of hypervisors based on energy consumed by the hypervisor and their performance based on the workload applied.

Key words: OS Virtualization, Hyper-V, Xen, KVM, Oracle VM

INTRODUCTION

Cloud computing embarks on an unassuming journey within the IT Business and Computer. Cloud computing gives users access to data storage and processing power (Osorio *et al.,* 2006; Thein *et al.,* 2008; Ye *et al.,* 2011). The immediate resolution of cloud computing is to address the plethora of issues due to the rapid expansion of businesses and their data. For delivering the actual data, it offers a variety of resources such as hardware services, application services, database services, and storage services. Cost-effectiveness, scalability, productivity, on-demand service provision, pay-per-use policy, high performance, reliability, elasticity and resource movement facility are just a few of the fundamental aspects of cloud computing (Kapil, 2019; Xiang *et al.,* 2012; Dordevic *et al.,* 2021).

Motivation

This research looked at several different jobs with their own set of quality-of-service requirements (e.g., deadline, priority and workload). Therefore, selecting a suitable virtual machine from a diverse resource set with minimal energy consumption and a task's met QoS has become a complex scheduling problem.

- This research provides a system architecture for processing jobs on heterogeneous computing virtual machines under tight deadlines using various components. The system comprises multiple virtual machines, and the scheduler will determine how and where positions will be assigned based on the quality of service criteria.
- The initial phase in the scheduling problem is the work sequence rule, and the study generates new rules to ensure the quality of services required during scheduling.

Methodology

This section will go through the basics of virtual machine placement before proposing a solution to the problem.

Problem Statement

One of the most critical technologies in cloud computing systems is Operating System virtualization. This technique allows several virtual computers to be installed and run on a single physical machine. Requests are reviewed now and then and formed into virtual machines, subsequently assigned cloud infrastructure resources (Hwang *et al.,*2008; Shuja *et al.,* 2016). A pool of physical machine resources with varying capacities exists in a cloud computing environment. The virtual machine placement challenge is mapping several virtual machines to a group of physical computers. This procedure is critical for optimal resource utilization and energy consumption in cloud infrastructure. However, offering an efficient solution is not an easy task due to request and physical machine heterogeneity, multi-dimensionality of resources, and enormous scales. This mapping must be created to meet the primary requirements of a data centre, such as reducing energy usage and costs while increasing profits (Figure 1).

Experiment Setup

To comprehensively compare the hypervisor's workload and Dynamic memory efficiency, we selected three different hardware platforms as our testbed. The testbed configuration is given in Table 1.

Experiment Workloads and Its Classification

On top of the hypervisor, we ran two different Virtual Machines with two different workloads. We used a program written in R programming to figure out prime numbers. Java,

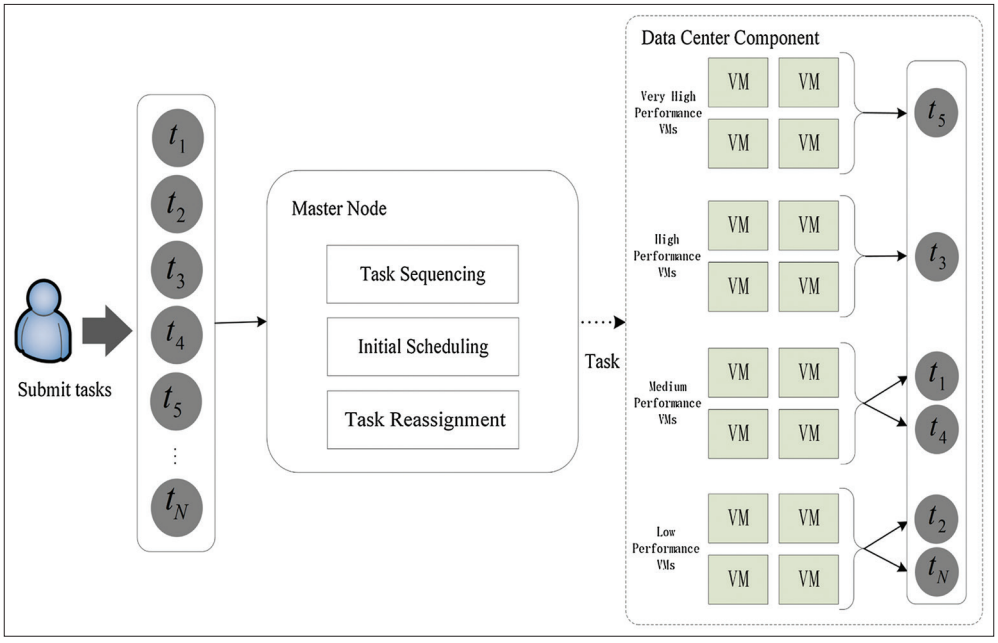

Figure 1: The proposed architecture

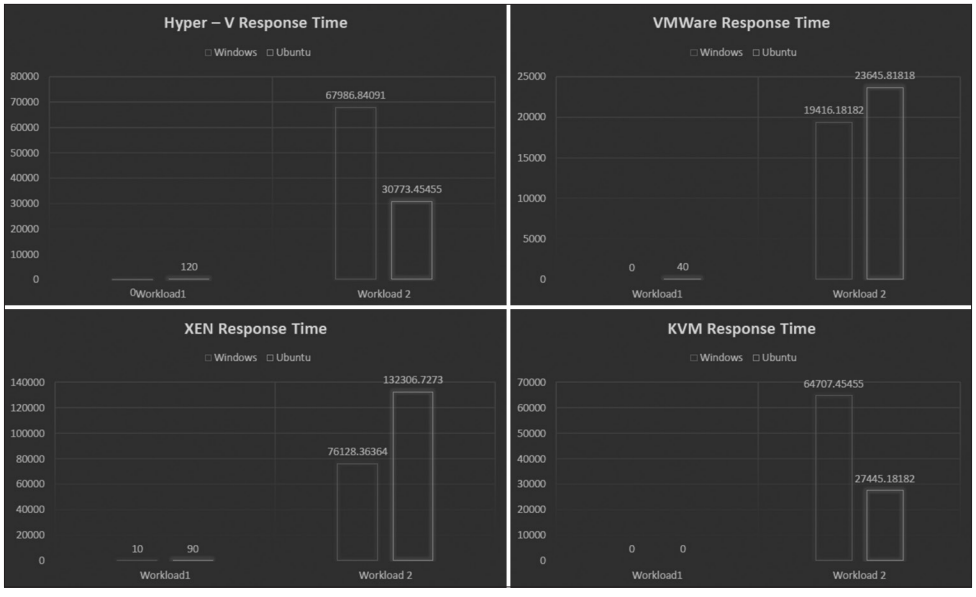

Figure 2: Response Time of hypervisors

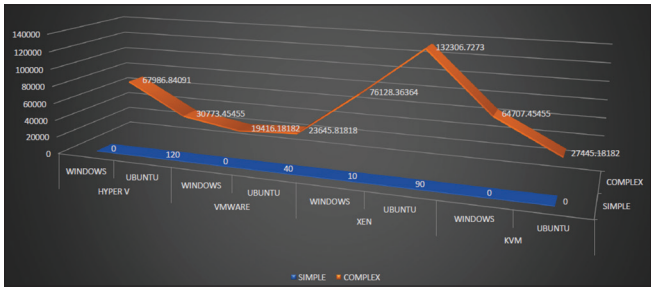

Figure 3: Overall analysis of response time

namely simple excellent and Complex Prime. Simple Prime is an ordinary program to find whether the given number is prime or not. The second Complex Prime is written using recursion, executed for prime search; it calculates and searches for prime numbers in 50 intervals. The Response time of each execution was calculated and noted, and taken an average of them for comparison purposes.

Table 1: Platform Configuration

Platform	Laptop	Cores	Memory	Storage	CPU
Dell X66 Based PC	Laptop	4	8 GP	512 SSD	Intel i5
Hp X64 Based PC	Desktop	4	8 GP	512 SSD	Intel i3

Table 2: Response Time Values of Type 1 Hypervisors

Workload/VM	HYPER V		XEN		KVM	
	WINDOWS	UBUNTU	WINDOWS	UBUNTU	WINDOWS	UBUNTU
SIMPLE	0	120	10	90	0	0
COMPLEX	67986.84091	30773.45455	76128.36364	132306.7273	64707.45455	27445.18182

RESULTS AND DISCUSSION

We have compared the response time of Hyper -V, Xen Server, KVM, VMware on various platforms, including a desktop and a laptop. First, we run two different prime searches on the platform (Jiang *et al.,* 2019). The simple Prime and complex prime search has given different response time values. The values are noted for each hypervisor, as shown in Figure 2. An overall analysis of four different hypervisors was given in Figure 3.

Overall Result Analysis

From observation one and observation two, we can come to an analysis that

a. The hypervisor, hardware, and type of workload are all connected [4]. This caused design engineers to be careful when choosing hypervisors for virtualized infrastructure and cloud data centres.
b. Objective 1: From Table 2, objective 1, the response time values for Windows-VM and Ubuntu-VM are less for the KVM hypervisor.

CONCLUSION

There are several virtualization platforms available today, ranging from open-source hypervisors to commercial hypervisors. Type 1 hypervisors are those that run directly on top of the hardware, whereas Type 2 hypervisors are those that run as an application within an operating system (OS). Based on workload and memory, this article compares the performance of Microsoft (MS) Hyper-V, VMware ESXi, and Xen. Our findings reveal that different hypervisors on the same hardware with the same workload have varying reaction times and memory characteristics. Furthermore, different hypervisors have distinct features and can handle different workloads and levels of workload. They can also be employed for various levels of work in various power circumstances. In the future, this single system hypervisor will be able to be tested in a cloud environment with even more complex workloads, and the Type2 hypervisor will be further investigated. There are many different virtualization platforms available today, ranging from open-source hypervisors to commercial hypervisors. Type 1 or Type 2 hypervisors are available. Hypervisors of type 1 run on top of the hardware, while hypervisors of type 2 run inside an operating system (OS)

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