The Ciência & Engenharia - Science & Engineering Journal
ISSN: 0103-944X
Volume 11 Issue 1, 2023
pp: 55 - 64

Optimizing Surplus Resources To Private Cloud

Harsh Oswal
Department of Engineering
AISSMS College Of Engineering
Pune, India

Shashikant V.Athawale
Department of Computer Engineering
AISSMS College Of Engineering
Pune,India

Ediga Lalit Kumar
Department of Engineering
AISSMS College Of Engineering
Pune, India

Aishwarya Pawar
Department of Engineering
AISSMS College Of Engineering
Pune, India

Prasad Mache
Department of Engineering
AISSMS College Of Engineering
Pune, India

Abstract- A special set of capabilities made available by cloud computing make it a very effective and scalable hosting solution. To host their software and applications in the Cloud, all commercial enterprises and academic institutions make use of one hosting platform or another. Additionally, a lot of these organisations or companies have excess or underused computing resources, even though they are fully functional but lack the necessary capacity to function as a standard workstation, leading to the creation of e-waste. The method for combining these extra computing resources into a single datacenter Private Cloud that can execute applications, containers, and virtual machines is presented in this paper. Its effectiveness for various types of hypervisors is then tested.
Keywords—component, formatting, style, styling, insert

Introduction

Since its inception, cloud computing has gained popularity. The idea of obtaining real-time data truly whenever and wherever they choose has sparked the interest of computer science enthusiasts. Everyone may now access any data from anywhere in the world by using the internet, kudos to this innovation. The ease with which data recovery is possible is a significant contributing factor to its popularity. For instance, it is possible to create a remote disaster recovery site that can swiftly restore data following a disaster, minimizing data loss.

As a result, it does more than merely store data; it also secures it. For this reason, a lot of organizations are utilizing the cloud to host their software.

Numerous large organizations, such as corporations, have an abundance of computing resources that are in fine working order but aren't used because they are either preserved as buffer stock or are being replaced by comparatively younger technologies. In this study, an experiment is carried out to utilize these extra resources which would otherwise be considered e-waste in order to integrate them all into a single private cloud. Utilizing several hypervisors, their performance relationship is investigated.

In order to better understand cloud computing, this paper first provides a quick introduction to virtualization. It then examines a few virtualization platforms before moving on to explore Hypervisors, a key component of virtualization. After setting the groundwork, it converges to adequately explain the experimental arrangement, in which three surplus resources are combined to create a private cloud. The observations were presented as graphs that compared the amount of memory that was actually available to the amount of memory that was theoretically available. Bar graphs were then used to compare how well Virtual Machines and Containers performed when running various operating systems on various hypervisors. The research is then mathematically supported, and a formula to determine the useful values of the surplus resources is derived.

A. *Private cloud*

A private cloud, often described as a "Corporate Cloud," serves the requirements of a single business or organization as opposed to many in the Public Cloud. It provides almost all of the advantages of public cloud computing, but with a unique architecture. It has full control over the supporting infrastructure [12]. The servers are located in their own data centers, and the private cloud organization is prohibited from having to share its resources with any other users. These assets and infrastructure may be brand-new or pre-existing. VMware and Open Stack are two prominent examples of vendors.

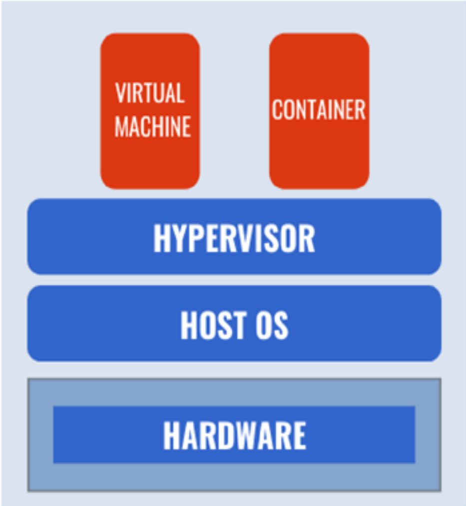
B. *Virtualization*

An essential component of cloud computing is virtualization. The process of creating many virtual instances on one or more physical computing hardware is implemented in cloud computing. Virtualization allows several users to share the same computational resource at once by replacing physical files, servers, and networks with computer-generated equivalents. Applications are run through a hypervisor and a web- or software-based GUI; networking and storage can also be virtualized. Virtualization has shown to be a highly economical and cost-effective approach because in reality just one computer resource is consumed.

1) *Type 1 Hypervisor*

A Type 1 Hypervisor, also known as a "Native Hypervisor" or "Bare-metal Hypervisor," operates directly on the underlying host system or "bare" system without the use of a base operating system. It is also known as "native" and may now access hardware resources. It functions as an operating system all by itself. These hypervisors are quite effective due to this characteristic. Additionally, each VM is shielded from harmful activity by attackers due to the lack of a meditative layer in between and their isolation. VMware ESXi, Microsoft

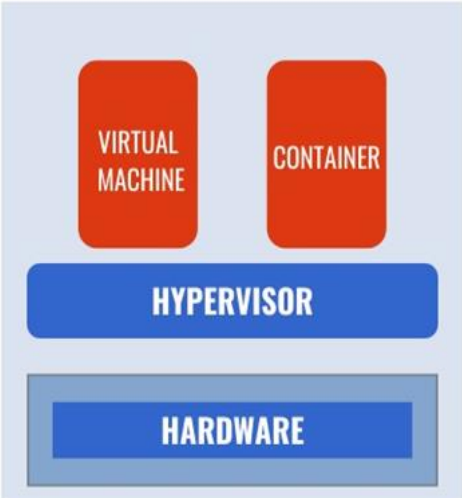
Hyper-V, and Proxmox are a few examples of Type 1 Hypervisors. The architecture is depicted in Fig. (1).



2) Type 2 Hypervisor

The Type 2 Hypervisor, often known as the "Hosted Hypervisor," runs on top of an already installed operating system. To access network resources, storage, etc., they must go through the host machine's operating system. They have an underlying layer of software, unlike Type 1. They function well in a more controlled setting, such as one with a small number of servers.

Because Type 2 hypervisors already have a built-in management console, there is no need to add a second one. There is a certain latency that develops in these types of hypervisors since every virtual machine's procedures and activities must go through the host operating system. VMware Player and Virtual Box are a few examples. The structure is displayed in Fig. (2).



3) VMWARE ESXI

The bare-metal hypervisor in the VMware virtualization platform is called VMware ESXi. Elastic Sky X Integrated is the meaning of the "ESXi" in its name. Because it is a Type 1 Hypervisor and runs directly on the host system, it performs better and more quickly than

The Ciência & Engenharia - Science & Engineering Journal
ISSN: 0103-944X
Volume 11 Issue 1, 2023
pp: 55 - 64

other types. The ESXi servers are managed by the VMkernel operating system, which serves as a bridge between the OS and the virtual machines that operate on top of it. The hardware requirements are much lower due to its small code base.

4) PROXMOX

Proxmox VE is open-source server management software for enterprise virtualization. For high-availability needs, it is natively optimized. With its built-in web interface, managing VMs, containers, etc. on a single platform is comparatively simple. The production environment's flexibility is greatly boosted because it integrates two virtualization technologies on a single platform. Linux and VM applications can both be run on it.

Literary Review

Numerous organizations possess extra, usable but low-powered computing resources. This leads to unwanted challenges and a rise in e-waste. Numerous studies and white papers are available on hypervisors, virtualization, and constructing a private cloud in a data centre, but the most of them are aimed toward enterprise-grade servers or resources, and very few of them emphasize on surplus or low-end resources that can be used as a cloud.

The phrase "C-Cloud" was first used by Partha Dutta et al. in the study "C-Cloud: A Cost-Efficient Reliable Cloud of Surplus Computing Resources”, which also explored the idea of allowing anyone to share their surplus resources. It concentrated on giving consumers a low-cost option to cloud hosting as well as a chance for resource owners to make money from their unused resources. The performance of several hypervisors, including Hyper-V, KVM, Xen, and VMware, is the main topic of this paper's research and analysis. This study makes use of some tried-and-true benchmarking tools, like File bench.

By running a single-core benchmarking on the host virtual machines and containers, it compares the hypervisors for surplus resources explicitly and attempts to offer a mathematical foundation for computing the practically useful results in the private cloud.

Testing Methodology

As demonstrated in Tables I and II, the single score CPU performance of virtual machines and containers is compared by allocating the same number of resources to each.

Resources	WINDOWS	UBUNTU
Memory (Mb)	4096	2048
CPU Cores	4	4
Storage (Gb)	64	32

TABLE I. RESOURCE ALLOCATION FOR VIRTUAL MACHINES

Resources	CentOS	UBUNTU
Memory (Mb)	2048	2048
CPU Cores	4	4
Storage (Gb)	10	10

TABLE II. RESOURCE ALLOCATION FOR CONTAINERS

The Ciência & Engenharia - Science & Engineering Journal
ISSN: 0103-944X
Volume 11 Issue 1, 2023
pp: 55 - 64

Software Used:
Geek bench V5.4.4 is used for benchmarking purposes.
Images Versions:
Ubuntu 20.04.03 LTS
CentOS 8
Windows 2019 Standard with Desktop Experience

Term	Meaning
N	Number of servers in the cluster
R_{th}	Theoretical Available Memory (in Gb)
R_N	Theoretical Total Available Memory in the N^{th} server (in Gb)
R_p	Practically Available Memory for use in the cloud (in Gb)
S_{th}	Theoretical Available Storage (in Gb)
S_N	Theoretical Total Available Storage in the N^{th} server (in Gb)
S_p	Practically Available Storage for use in the cloud (in Gb)

TABLE III. ABBREVIATIONS USED IN THIS PAPER

System Architecture

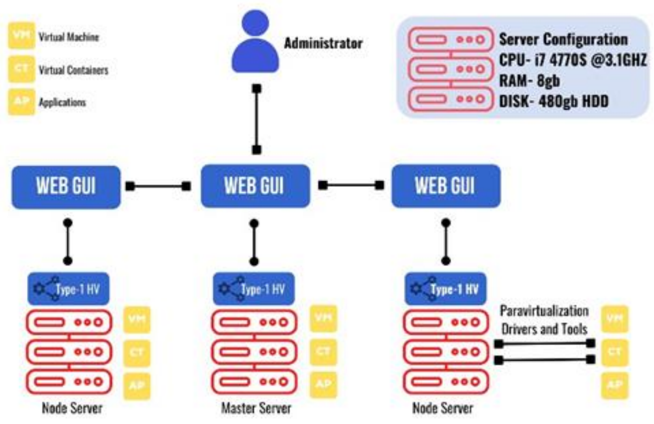


Fig. 3: System architecture

The Ciência & Engenharia - Science & Engineering Journal
ISSN: 0103-944X
Volume 11 Issue 1, 2023
pp: 55 - 64

Result

C. Type 2 hypervisors are not at all efficient due to the excess resources being used, as running the host OS wastes resources, reducing the amount of practically accessible resources and lowering performance. On the other hand, type 1 hypervisors offer far better virtualization and less resource utilisation, resulting in great performances.

D. ProxMox VE

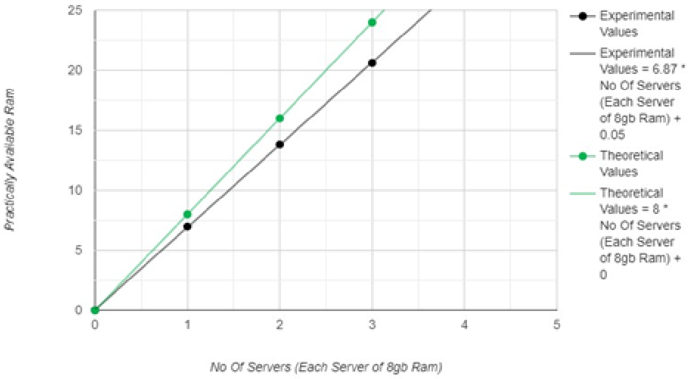


Fig. 4: Proxmox number of servers to practically available RAMS

The hypervisor needs a certain amount of RAM to operate its operations and accomplish virtualization when the resources are clustered together.

The relationship between the number of servers added and the theoretically and practically accessible RAM is plotted in Fig. 4.

Using linear regression, the line of best fit has been drawn on the graph.

Each server does have a single channel of 8GB memory

1) For memory

- *Idle Case:*

$$R_{th} = \sum_{N=1}^{N} R_N \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (1)$$

- *Practical Case:*

$$R_p = R_{th} - (1.13\mathrm{N} + 0.05) \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

Deduced from the Graph Fig. 4

2) For Storage

- *Idle Case:*

$$S_{th} = \sum_{N=1}^{N} S_N \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

The Ciência & Engenharia - Science & Engineering Journal
ISSN: 0103-944X
Volume 11 Issue 1, 2023
pp: 55 - 64

- *Practical Case:*
  $S_p = S_{th} - (2.47\text{N})$.. (4)

  Proxmox VE 7 was used throughout the experiment.

E. *VMware EXSI*

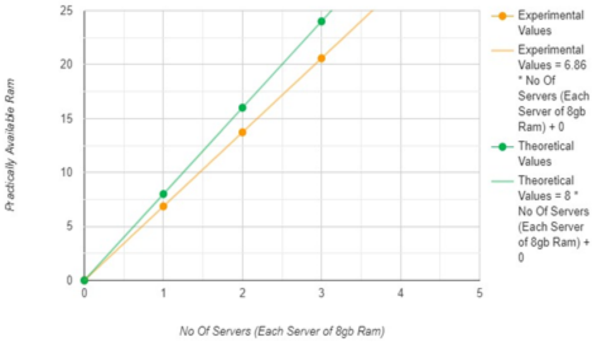


Fig 5: Esxi Number Of Servers To Practically Available Ram

Multiple ESXi host servers have been established and clustered on another server using Vcenter in Fig. 5 of the experiment mentioned above.
Utilizing linear regression, the graph has been drawn using the line of best fit.
Each server does have a single channel of 8GB memory.
1) For memory

- *Idle Case:*

$$R_{th} = \sum_{N=1}^{N} R_N \quad \text{...} (5)$$

- *Practical Case:*

  $R_p = R_{th} - (1.14N)$.. (6)
  Deduced from the Graph Fig. 5

  2) For Storage

- *Idle Case:*

$$S_{th} = \sum_{N=1} S_N \quad \text{...} (7)$$

The Ciência & Engenharia - Science & Engineering Journal
ISSN: 0103-944X
Volume 11 Issue 1, 2023
pp: 55 - 64

- *Practical Case:*

$$S_p = S_{th} - (1.41N) \quad (8)$$

F. *Benchmarking the VM*

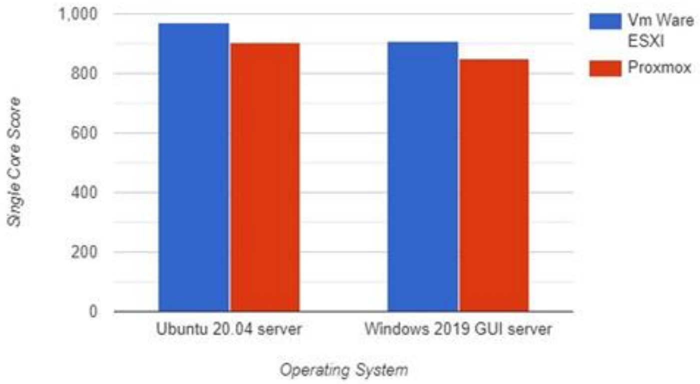


Fig. 6: Performance of Virtual Machine

Using Proxmox VE 7.0 and VMware ESXi 6.7 as hypervisors, Fig. 6 depicts the single core scores of the virtual machines using Geek bench 5.4.4 on Ubuntu 20.04.03 LTS and Windows 2019 Standard with Desktop Experience.

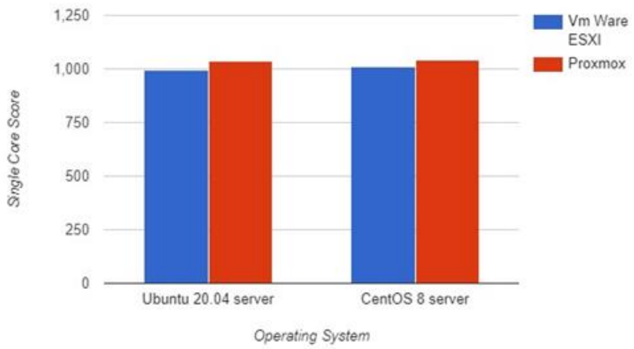


Fig. 7: Performance of Virtual Container

Due to VMware ESXI's inability to create containers natively, PhotonOS (a lightweight operating system used for containerization) is utilized as the VM's base OS and a docker engine is installed on it. Both hypervisors share the same resource allotment for the containers.

Discussion Of The Result

- Proxmox holds a stronger position when considering the ease of installation and GUI use. As a communal project, it is additionally frequently updated (Open Source).
- On each server, Proxmox 7 needs 2.47GB of disc space, compared to 1.41GB for ESXI 6.7.
- Both Proxmox 7 and ESXi 6.7 utilize roughly the same amounts of RAM when they are idle; Proxmox consumes more when clustering.

- ESXI works remarkably well when operating virtual machines, according to the performance results.
- Proxmox supports LXC containers; however VMware ESXi's VMkernel prohibits it from running containers natively.
- Hence, a lightweight virtual machine must be added and a docker engine must be running on it in order to execute containers on VMware ESXI.
- The performance of the containers is quite excellent, despite the fact that they are running inside the virtual machine.
- Proxmox beats ESXi when it comes to container performance
- ESXi and Proxmox both perform a great job of utilizing surplus resources
- By making the Private cloud accessible over the internet, it can be accessed remotely

Conclusion

- By utilizing all available computing power from the underutilized resources as a collective entity to address the given problem, this architecture of surplus resources to the private cloud considerably reduces e-waste.
- For surplus resources, a type I hypervisor is preferable. Using Type 2 hypervisors for surplus resources is inefficient since doing so leads in resource wastage, which reduces the availability of practically accessible resources and lowers CPU and disc performance.
- Type 1 hypervisors offer significantly better virtualization and use the fewest resources possible, resulting in good performances.
- Excellent accuracy can be seen in the formula derived from the results.
- The resulting private cloud is simple to maintain and has the ability to run containers or virtual machines for modern applications.
- Since it never leaves the data centre, the data is secure in the private cloud.
- Hybrid architecture can be created by simply integrating this private cloud with the public cloud.

Acknowledgment

We would like to express our heartfelt gratitude to the scholarly concerned, as well as our guide, Mr S V Athawale, for valuable guidance and support, inspiration, and assistance, without which we would not have been able to complete this research paper. We would also like to sincerely thank Mr S V Athawale, HOD Computer Science Engineering at AISSMS COE, for providing all facilities and words of encouragement while we worked on this research paper. Finally, we would like to express our gratitude to everyone who assisted and guided us, directly or indirectly, in the completion of this research paper.

References

[1] Ramakrishna Subbareddy and Dr B. Firdaus Begam (2021), International Journal of Scientific & Engineering Research Volume 12 Issue. 2, pg. 264-268

[2] Borislav Đorđević and Valentina Timčenko (2021), 20th International Symposium INFOTEH-JAHORINA (INFOTEH),

[3] Ramanujam Veluchamy (2020), Mukt Shabd Journal Volume IX, Issue IV, APRIL, pg. 2347-3150

The Ciência & Engenharia - Science & Engineering Journal
ISSN: 0103-944X
Volume 11 Issue 1, 2023
pp: 55 - 64

[4] Bohar Singh et. al (2018), International Journal of Computer Science and Mobile Applications, Vol.6 Issue. 1, pg. 17-22
[5] P. Vijaya Vardhan Reddy and Lakshmi Rajamani (2014), 5th International Conference - Confluence The Next Generation Information Technology Summit (Confluence), pg. 18-23
[6] “Type 1 and type 2 hyperviors explained,” [online] Available: https://www.vembu.com/blog/type 1-and-type 2-hypervisor/ .
[7] “Hypervisors,” [online] Available: https://www.geeksforgeeks.org/hypervisor/?ref=lbp .
[8] “Proxmox Admin Documentation,” [online] Available: https://pve.proxmox.com/pve-docs/pve-admin-guide.html .
[9] Jennifer Seaton, “VMware ESXi server,” [online] Available: https://www.techopedia.com/definition/25979/VMware-ESXi-server .
[10] Kevin Wood, “10 benefits of cloud hosting,” [online] Available: https://www.hostgator.com/blog/benefits-cloud-hosting/ .
[11] Elytus, Ltd., “E-Waste & its Negative Effects on the Environment,” [online] Available: https://elytus.com/blog/e-waste-and-its-negative- effects-on-the-environment.html
[12] Ben Lutkevich, “What is a private cloud?,” [online] Available: https://searchcloudcomputing.techtarget.com/definition/private-cloud
[13] L. LApriliana, D. Kucuk, N.N Diana(2018), (JOINTECS) Journal of Information Technology and Computer Science Vol. 3, No. 1
[14] Sultan Abdullah Algarni, Mohammad Rafi Ikbal, Roobaea Alroobaea, Ahmed S Ghiduk, Farrukh Nadeem (2018), International Journal of Open Source Software and Processes