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Importance of Virtualization Technology in Cloud Computing System

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ABSTRACT: ***While generating considerable cost savings, virtualization may boost IT agility, flexibility, or scalability. Advantages of virtualization include higher workload mobility, improved resource availability or performance, automated processes, easier management, and lower ownership and operating costs for IT. The ability to create an intelligent abstraction layer that conceals the complexity of underlying software or hardware makes virtualization a crucial component of cloud computing. This article covered virtualization, technological architecture, as well as Virtual Machine Monitoring (VMM). In addition, there have been explored about virtualization, its benefits, how it applies to cloud computing, and any advantages or drawbacks that exist between physical and virtual servers. This paper emphasizes the significance of virtualization technology in streamlining IT processes and enabling IT teams to react quickly to shifting business demands. The main objective of this paper learns more about the importance of virtualization technology in the cloud computing system. In the Future, this paper will aid people to understand the utilization of virtualization technology and its advantage.***

KEYWORDS: ***Cloud Computing, Technology, Software, Virtual Machine, Virtualization.***

1. INTRODUCTION

In the field of IT, virtualization is indeed a developing technology. An increasing number of businesses are consolidating their workloads and using virtualization to increase the scalability and flexibility of their IT infrastructures [1], [2]. A virtual version of such a resource or equipment, such as a server, storage device, operating system, or network, is created through virtualization in computers. Application setup and migration processes are streamlined in addition to high availability for essential applications that are simply provided through virtualization. With virtualization, a combination of hardware and software innovation, many operating systems may now run on the same physical platform [3], [4]. Storage virtualization is the technique of combining the physical storage resources of several network storage systems into what appears to be a single storage device that can be managed from a single console.

In SAN, storage virtualization is often used, and it is normally carried out by software [5], [6]. Storage virtualization establishes an abstraction layer between server-based applications and storage. Storage virtualization generally has benefits like migration, usage, and administration, but it also has problems such as a lack of standards or interoperability, back out, or metadata [7], [8]. Server virtualization makes it simple to shift operating systems across different types of hardware and allows several operating systems to share the same hardware. To optimize your server resources (which include the identity or number of unique virtual servers, operating systems, as well as CPUs), server virtualization divides a physical server into smaller virtual servers. There are several advantages to server virtualization, including increased hardware usage, security, and development [9].

1.1. The Primary Virtualization Techniques:

Virtualization may be divided into numerous different forms based on the components they are applied to.

1.1.1. Virtualization of Servers:

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By combining numerous PCs onto a single server, which subsequently hosts multiple virtual environments, server space is saved. Businesses can use this technique to run identical programs on several servers, creating a "fail-safe" posture. Automatic failed mitigation techniques based on the predicted circumstances are possible with a fail-safe system design. Software operating on one server won't influence the other since they are independent of one another [10]. Additionally, the rapid growth of cloud computing and app-based services has led to the emergence of the software as a service (SaaS) industry. According to the most recent Allied Market Research analysis, the SaaS market is projected to reach $702.02 billion by 2040, which indicates that virtualization will only improve the quality of business processes and business prospects.

1.1.2. Virtualization of Storage:

Disk storage can be straightforward. A firm just buys a bigger disc drive if it needs more. Storage is becoming harder and harder to manage as they expand to accommodate all that data. In 2020, Statista estimates that worldwide enterprise data volumes will range from 1 petabyte (PB) to 2.04 petabytes. The massive amount of data currently collected by enterprises can be effectively addressed by virtualization technologies. The application no longer needs to identify where specific data is located because it places another layer of software between the system and the server. It is treated as a single resource for management purposes. Each storage device will see the virtualization layer as its only server, while the server will see the layer as a single storage device.

1.1.3. Virtualization of Networks:

With this kind of virtualization, a complete network may be managed and watched as a single unit. Its main purpose is to automate administrative processes and hide the network's complexities. Each server is regarded as a component of a single pool of resources that may be used without concern for its hardware elements. Network virtualization (NV) is a technique for combining network resources that involve dividing the available bandwidth into different parts of the network that may each be assigned to and reassigned to a specific server. Network Virtualization (NV) is a term used to cover a variety of concepts, including distributed systems, storage virtualization, and grid computing. It involves the usage of resources (networks) through the logical division of a single physical network. Consolidation or Access Customization are two typical advantages of network virtualization [11].

With application virtualization (AV), each program pulls forward its own set of configurations and operates in a way that allows only its settings to be viewed, thereby spreading computer resources dynamically in real-time. The benefits of application virtualization include security, legacy support, management, and accessibility. The drawbacks of application virtualization include resources. Memory virtualization involves both sharing and dynamically generating virtual machines with real system memory (VMs). Similarly, contemporary OS systems allow virtual memory, and virtualized memory virtualization, as shown in Table 1.

Table 1: Illustrate Before or after virtualization comparison.

Before Virtualization	After Virtualization
Underutilized resources and one OS image per computer.	Applications or the OS are hardware independent.

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Conflict frequently results from running different apps on the same system.	Able to control OS and applications as a unified entity by isolating them in virtual machines (VMs).
Software and Hardware are closely related, and the infrastructure is expensive and rigid.	Any system may be supplied with virtual machines (VMs).

1.2. Techniques of Virtualization:

1.2.1. Method 1-Binary Translation and Full Virtualization:

With novel sequences of instruction that have the desired impact on the virtual hardware, this strategy uses binary translation to both virtualize and trap some sensitive or non-virtualizable instructions. To achieve high-speed virtualization, user-level code is directly performed on the CPU during runtime manipulation of the OS's binary image. Full Virtualization is made possible by the combination of online execution and binary translation since the virtualization layer entirely decouples the guest OS from the underlying hardware. Examples of complete virtualization are VMWare ESXi and Microsoft Virtual Server. This method's performance is less than optimal, especially when doing I/O-intensive tasks.

1.2.2. Method 2-Paravirtualization or OS-Assisted Virtualization:

Paravirtualization mainly deals with the communication between the guest OS and the hypervisor, to increase productivity or performance. The OS kernel must be changed as part of the paravirtualization process to replace non-virtualizable commands with hyper calls that connect directly to the virtualized layer hypervisor. The hypervisor provides the hyper-call interface, including other important kernel functions such as interrupt control, memory management, and timekeeping.

1.2.3. Method 3-Hardware-assisted virtualization:

The new CPU execution mode feature in AMD's AMD-V or Intel's Virtualization Technology (VT-x) enables the VMM to run in a new root mode below ring 0 (Ring 0P - privileged root mode), while the Guest OS runs in Ring 0D. (For de-privileged non-root mode). Because sensitive as well as privileged calls are designed to immediately trap to the hypervisor but also be handled by hardware, binary translation, as well as par virtualization, are not required.

2. DISCUSSION

Virtualization's fundamental premise is that a piece of software will behave and "look" like hardware to operate as a physical entity. As a result, it will carry out all of its functions even without the hardware being present. Server-side software imitates a desktop PC or other device as a consequence. A cloud-based IT solution essentially offers the following: a location where business processes may run and data can be stored without the need for on-site hardware, in table 2 advantages and disadvantages are shown. The ability to employ hardware in several industries was changed by the development of virtualization technology. Increasing virtualization of networking, storage, or servers enhanced efficiency or performance metrics for enterprises in need of strong and dependable infrastructure. Remote work is now more conceivable thanks to the better access that users and workers have to apps and desktops.

2.1. Purpose of Virtualization:

People should consider these several compelling justifications for using virtualization technology:

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a) Reduced power usage, and resource efficiency.
b) Reduced costs, or data center consolidation.
c) Makes system management tasks easier.
d) The ability to test live CDs without having to burn them to disks or restart the machine.
e) The management is easier.
f) Increasing Uptime.
g) Simpler software installation.
h) A rise in CPU use of 65-85% from 5-20%.
i) Better use of hardware.
j) Beneficial to the environment.
k) Any x86 server may operate a virtual machine.

2.2. Importance of Virtualization in Cloud Computing:

a) Compute resources are abstracted by virtualization.
b) Virtualization makes it possible to scale resources quickly.
c) Cloud computing is still possible without virtualization, but it will be ineffective and challenging.
d) The idea of Pay for what you use, and endless availability, is made possible by cloud computing.
e) Only because people have flexibility and efficiency on the back end are these ideas realistic.
f) Both machines and virtualized environments can easily use this efficiency.

Table 2: Comparison of the benefits and drawbacks of physical and virtual servers.

Traditional server		**Virtual Server**	
Advantage	**disadvantage**	**Advantage**	**Disadvantage**
Easy to deploy and backup	Hardware that is expensive to buy and keep up.	Resource pooling or simple server deployment.	A little more difficult to imagine.
Easy to conceptualize	Implementing redundancy is challenging and not particularly scalable.	Extremely available and redundant.	A little more expensive.
With this arrangement, practically any application or service may be used.	Difficult to duplicate and underuse CPU.	Adaptable when services are in use.	

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3. CONCLUSION

The emphasis on virtualization in the IT sector has grown significantly during the past several years. Virtual computing, which enables maximizing computer use while minimizing the related overhead costs of administration, power consumption, maintenance, but also physical space, would be the foundation of business IT management in the future. In addition, to support CPU or I/O virtualization, a robust VMM ecosystem, as well as a thorough roadmap to solve virtualization concerns are all provided by virtualization. The importance of virtualization technology in improving IT operations and enabling IT teams to respond more quickly to changing business needs is highlighted in this paper. The major goal of this paper is ssto increase your knowledge of the value of virtualization technology in cloud computing systems. This paper will assist readers in understanding how to use virtualization technology and its benefits in the future.

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