

Survey on Major Virtualization Techniques

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ABSTRACT

Virtualization facilitates the sharing of a single physical instance of a resource or application among multiple clients and businesses. It accomplishes this by assigning a logical name to physical storage and providing a reference to that physical resource when necessary. Virtualization stands as a pivotal technology within the realm of cloud computing, enabling a computing environment to concurrently execute several independent systems, commonly referred to as virtual machines (VMs). These VMs share the underlying physical IT infrastructure and are managed and coordinated through an additional software layer known as a hypervisor. The integration of virtualization into cloud systems is revolutionizing the field of IT. Despite its widespread adoption, certain concerns have emerged, posing obstacles to its broader implementation. This paper undertakes a study of these virtualization concerns.

Keywords:-Virtualization, Isolation, virtualization Types, hybrid, Para-Virtualization, Cloud Security

INTRODUCTION

Cloud computing offers a wide range of services, from simple word processing to complex data analysis, improving enterprise IT infrastructure performance without hefty investments. Businesses are

transitioning to cloud-based data centers to reduce maintenance, labor, and hardware costs, while also enhancing scalability and elasticity. However, it's crucial to assess risks and legal considerations carefully.



Fig.1:-Virtualization in Cloud Computing.

Virtualization in cloud computing arises from the necessity to optimize resources

and enhance security within computing environments. By segmenting server

capacities into smaller units, resources can be efficiently distributed among various users and environments. This process involves assigning logical names to physical storage, which can be accessed on demand, and creating virtual environments for memory, networking, and storage. Typically, virtualization involves a host machine and a guest machine, contributing significantly to Infrastructure as a Service (IaaS) delivery in cloud computing. Cloud computing offers numerous benefits, including reduced operating costs, space and energy savings, and improved availability. However, it also introduces security risks, particularly in handling the hypervisor as a real-time operating system. Extra configurations, such as user authorization, may be necessary to mitigate these risks on virtual operating systems.

CHARACTERISTICS OF VIRTUALIZATION

Virtualization in cloud computing encompasses various characteristics, including sharing, emulation, isolation, and increased security.

- 1) *Sharing*: Virtualization allows businesses to create multiple computing environments on the same host, reducing the number of active servers and energy usage. It enables the aggregation and sharing of physical resources among different virtual hosts, aiming to present a homogeneous group of machines' physical resources as a single source.
- 2) *Emulation*: Emulation involves executing multiple guest programs within a controlled environment provided by the virtualization layer. This enables the emulation of entirely new environments to execute guest programs, even if they are not present on the physical host.
- 3) *Isolation*: Virtualization enables the execution of guest programs in separate and isolated environments, such as the operating system and applications. These

guest programs interact with the abstraction layer, which provides access to underlying resources. The virtual machine (VM) filters guest activities and prevents operations that could harm the host system.

- 4) *Increased security*: Virtualization enhances security by allowing the host to effectively control the execution of all guest programs. The activities of guest programs are filtered and managed by virtual management components, safeguarding the execution environment. With the above characteristics, virtualization in cloud computing also comes in different types

MAJOR TYPES OF VIRTUALIZATION

- 1) *OS virtualization*: OS virtualization facilitates the installation of multiple operating systems on a single server or workstation. Instead of considering the original operating system as the base-level system, a second operating system can be installed on a subset or partition. Each of these operating systems remains distinct and secured within containers. This capability enables enterprises to run multiple operating systems on a single machine, resulting in cost savings on hardware, storage, electricity, and other related expenses.
- 2) *Administrative virtualization*: This aspect involves the management of servers and devices, including access and permissions. Administrative virtualization isolates administrative tasks through a virtual layer, primarily applicable in data centers. It facilitates user segregation and establishes file-level privileges.
- 3) *Network virtualization*: Network virtualization empowers the management of multiple virtual networks, each with its unique data plan and management infrastructure. These virtual networks can be overseen by various entities and coexist within the same physical network framework.

Network virtualization offers a mechanism to establish virtual networks, encompassing switches, routers,

firewalls, VPNs, and other essential devices.

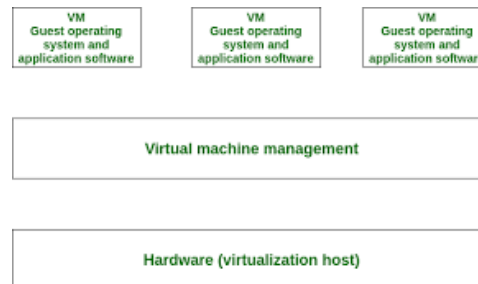


Fig.2:-OS Virtualization.

4) *Application virtualization*: Application virtualization involves maintaining virtual applications separate from the physical infrastructure, thereby not directly running on the physical infrastructure. Instead, they are executed through a virtualization layer, which simulates the provision of physical resources of the device to an application. It is typical to utilize virtualization tools in conjunction with virtual applications. Additionally, these applications can be deployed on virtual environments that

differ from the base-level operating system.

5) *Storage virtualization*: Virtual storage stands out as one of the most widely embraced methods in cloud computing. It serves to decouple the storage architecture from the underlying physical assets. Through virtual storage, physical storage components are integrated with other virtual resources to create a unified pool, which is then allocated and utilized as needed.

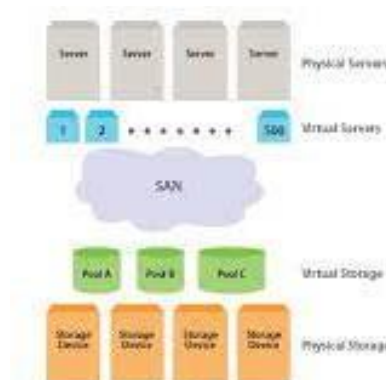


Fig.3:-Storage Virtualization.

This approach facilitates streamlined transfer processes, centralized management, and efficient storage utilization.

6) *Server virtualization*:: Server virtualization pertains to the distribution of server power and processing capabilities. Each virtual server operates

independently of others, enabling applications to utilize resources from any server. This process involves dividing a physical server into multiple virtual servers by altering the ID numbers.

7) *Desktop virtualization*:: Desktop virtualization is particularly useful for mobile workforces or individuals

frequently changing locations. These virtual desktops can be accessed via the cloud, allowing for seamless data access

and transfer regardless of the user's location.

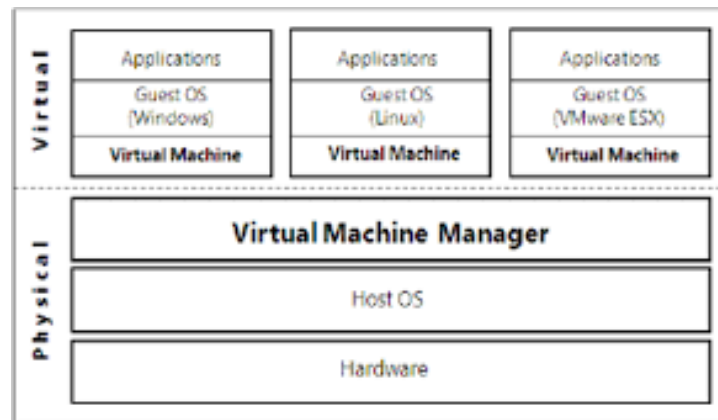


Fig.4:-Desktop Virtualization.

With the different types of virtualization available, it is easy to understand why managing the virtual infrastructure is essential when it comes to deriving its benefits.

LITERATURE REVIEW

Edren Dacaymat, Jun Zhang, Qi Wang, Md Alam Bhuiyan, and Thaier Hayajneh [1] delve deeply into the intricate realm of virtualization within the context of cloud computing, shedding light on critical security challenges that have emerged in this evolving landscape. With the escalating threat of cyberattacks, the authors underscore the paramount importance of fortifying defenses against malicious activities to safeguard sensitive information and maintain the integrity of cloud-based systems. Through meticulous analysis, the paper meticulously delineates various attack vectors targeting virtual systems, providing a nuanced understanding of the intricacies involved. The exposition begins by elucidating the nuances between distinct scanning software, notably Network Mapper (Nmap) and Metasploit, shedding light on their unique functionalities and capabilities. While Nmap excels in scanning open ports of internet connections and discerning the operating

systems in use, Metasploit emerges as a potent vulnerability detection tool adept at identifying and exploiting system flaws. By simulating two prominent types of attacks - Heartbleed and Denial of Service (DoS) - the authors offer valuable insights into the modus operandi of these threats, along with effective preventive measures to mitigate their impact.

Vimlesh Kumar and Rajkumar Singh Rathore [2] embark on a comprehensive exploration of security issues endemic to virtualization within the domain of cloud computing. They articulate the imperative of upholding robust virtualization security as a linchpin for overarching cloud security, delineating a spectrum of vulnerabilities and attack surfaces that necessitate vigilant attention. The discourse traverses the landscape of cloud computing and virtualization technology, offering an incisive comparative analysis of storage features proffered by leading cloud storage service providers.

Isaac Odun-Ayo, Olasupo Ajayi, and Chinonso Okereke [3] pivot their focus towards cloud storage systems, meticulously examining their architectures, operational modalities, and attendant challenges within the purview of virtualization in cloud computing.

Delving into the intricacies of virtualization, particularly within the realm of cloud containers, the authors navigate through the labyrinth of benefits, techniques, and challenges inherent in cloud storage. Despite persistent security and privacy concerns, the paper underscores the burgeoning growth trajectory of cloud storage and ongoing research endeavors aimed at enhancing its adaptability and resilience.

Rahul L. Paikrao and Dr. Varsha H. Patil [4] turn their attention towards addressing security vulnerabilities pervasive in cloud computing, with a particular emphasis on vulnerabilities emanating from virtualization. They meticulously identify and dissect major security concerns, drawing insights from the observations of the Cloud Security Alliance. Challenges such as isolation failure and VM mobility are scrutinized, with proposed strategies aimed at mitigating risks across diverse service models (SaaS, PaaS, IaaS).

Jitesh Kumar Meena and Rohitash Kumar Banyal [5] embark on an exploration of efficient virtualization practices in cloud computing, traversing through the intricacies of service and deployment models such as SaaS, PaaS, IaaS, and the nuanced dynamics of private, public, hybrid, and community clouds. The discourse extends to development methodologies, extolling the benefits while scrutinizing the drawbacks of cloud computing. Central to their narrative is the pivotal role of resource sharing and load balancing techniques in optimizing resource utilization efficiencies.

Manjeet Singh [6] navigates through the study of virtualization within cloud computing, elucidating its pivotal role in abstracting hardware and software to furnish a platform accessible from any

corner of the globe. The narrative underscores the overarching objective of virtualization - to fashion a platform conducive to unrestricted access and seamless resource sharing. Major cloud and virtualization service providers such as Google, Microsoft, and Amazon are spotlighted, underlining their catalytic role in shaping the digital landscape.

Anthony Tsetse, Samuel Tweneboah-Koduah, Bharat S Rawal, Zhihao Zheng, and Manoah Prattipati [7] undertake a comparative analysis of system virtualization performance, delving into the impact of virtualization on system efficiency across varied operating systems and configurations. Through empirical analysis, the paper delineates the performance metrics, shedding light on the nuanced dynamics between different operating systems. Various types of virtualization are explored, alongside an elucidation of the additional expenses incurred due to virtualization.

Jieguang He, Delong Cui, Zhiping Peng, Mian Guo, Qirui Li, and Jianpeng Lin [8] unravel the intricacies of virtualized resource scheduling within cloud computing environments, encapsulating the state-of-the-art research endeavors aimed at optimizing resource allocation and management. The exposition spans a spectrum of resource scheduling strategies, ranging from quality of service optimization to multi-objective optimization, underscoring the imperative of efficient resource utilization in fostering a resilient cloud infrastructure. Through a meticulous review of existing literature, the paper proffers invaluable insights and propels future research trajectories in the realm of cloud computing resource management and scheduling.

COMPARISON

In this section has two comparison tables.

| Deployment model | scope of services | owned by | managed by | security level | location |
|------------------|---|-----------------------|------------------------------|----------------|--------------------|
| public | general public and large industry groups | CSP | CSP | low | off premise |
| private | single organization | single organization | single organization or CSP | high | off or on premise |
| community | organizations that share the same mission, policy and security requirements | several organizations | several organizations or CSP | high | off or on premise |
| hybrid | organizations and public | organizations and CSP | organizations and CSP | medium | off and on premise |

Fig.5:-Comparison table on cloud deployment models

Table 1 describes the comparison of different deployment models in cloud computing.

Table 2 shows the comparison of different virtualization types

In the figure 5, we can see that the comparison of different cloud deployment modes such as Private, Public,

Community, Hybrid with basic parameters like Scope of service, security level, management etc. In fig 6, Para Virtualization, Full Virtualization and Hardware assisted virtualization are compared with parameters like modification of OS, Compatibility, Performance, Flexibility, Portability etc.

| | Full virtualization | Paravirtualization | Hardware-supported |
|-------------------------------------|---|---|--|
| Technique | Hypervisor provides a fully emulated machine in which an OS can run | Uses slightly modified version of OS which allows access to hardware resources as managed by the hypervisor | Exits to root mode on privileged instructions |
| Examples | VMware Server, Sun's VirtualBox, Microsoft Virtual Server, Parallels Server | Xensource's Xen, VMware | VMware Workstation, Microsoft Hyper-V, Xen 3.0, Virtual Iron |
| Modification of OS and guest | Both OS and guest applications unmodified | Modifies OS, but guest applications unmodified | Both OS and guest applications unmodified |
| Compatibility with Windows platform | Excellent (VMware, 2007) | Poor (VMware, 2007) Not available on Windows OSs | Excellent compatibility (VMware, 2007) |
| Portability | Excellent (VMware, 2007) | Poor (VMware, 2007) | Good |
| Flexibility | Highest | High | Low |
| Security | Best (VMware, 2007) | Very good | Good |

Fig.6:-Comparison table on different types of virtualization

CONCLUSION

Virtualization in cloud computing primarily stems from the need to split up

resources to make them more efficient and add security layers to silos of computing power. For instance, we can segment server

capacities into small parts to allow for the distribution of the server's capabilities among several environments and users. This paper gives the basic idea of past published paper of different virtualization techniques in cloud computing. With this survey and study, it has clearly find and observed that all the virtualization process, types, characteristics, models, security issues etc.

The technique uses the resource sharing and increases the system utilization. Using cloud-based virtualization solutions covering public and private cloud services and hybrid cloud services provide efficient use of the physical hardware, in turn improving the business ROI. In short, virtualization helps drive higher capacity utilization and reduced costs, making it worth the investment.

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