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VIRTUALIZATION: IN REAL LIFE APPLICATIONS

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Abstract

This paper shows how virtualization impacts the use of real-life applications across various industries, including cloud computing, data centers, gaming, healthcare, education, and many more. It plays an important role in security, scalability, as well as in cost efficiency while giving various challenges like performance overhead and dealing with complexities and also examines the future trends that helps in shaping virtualization in the best possible way.

Keywords- *Virtualization, Cloud Computing, Data Centers, Virtual Machines (VM), Desktop Virtualization, Network Virtualization, Storage Virtualization, Software-Defined Networking (SDN), Security in Virtualization, DevOps and Virtualization, Healthcare Virtualization, Virtual Desktop Infrastructure (VDI), Containerization, Virtualization in Education, Cloud Gaming*

1. INTRODUCTION OF VIRTUALIZATION

Virtualization is a technique that allows multiple servers to run on a single physical server. It involves transforming hardware into software, enabling more efficient resource utilization, improved scalability, and reduced costs. There are different types of virtualizations, including full virtualization, para-virtualization, and container-based virtualization, each offering various benefits for specific use cases. By enhancing flexibility and isolation, virtualization has become a key technology in modern IT infrastructure, powering cloud computing.

Fig1. Virtualization

2. KEY COMPONENTS OF VIRTUALIZATION

a) **Hypervisor (Virtual Machine monitor):** The hypervisor is the lowermost layer of software that helps in managing the hardware resources and creating virtual machine environments. it sits between hardware and operating system, to run the execution various virtual machine across a single physical host. there are two types of hypervisors: Type 1 (bare-metal), which runs directly on

physical hardware, and Type 2 hypervisor is also known as hosted hypervisor, which operates on the top of an existing operating system. Popular hypervisor include VMware EXSI, Microsoft Hyper v, and XEN.

b) **Virtual Machine (VMS):** A VM is a software- based emulation of a physical computer. VM has its own operating system (guest OS), application, and resources, all look after by the hypervisor. every VM is isolated from others, that processes in one VM do not interfere with others. This isolation allows for multiple operating systems to run on the same physical hardware.

c) **Virtualized resources:** Virtualization briefs physical hardware resources, like CPU, memory, storage, and network devices, and allows them VMs. Virtual resources are allotted and shared among multiple VMs, virtual resources improving resource utilization and flexibility. tools like virtual storage and virtual networking to improve resource management and isolation.

3. VIRTUALIZATION IN CLOUD COMPUTING

Virtualization was introduced to create non-existing versions of real-life resources like servers, storage, and networks to attain more accuracy and flexibility. It enables the cloud service providers to offer services as per the demand, allowing users to access computing resources when needed, without accessing the physical hardware. This technology also improves performance, making systems more secure, and helps in managing the workload between various distinct users. All the well-known cloud platforms including AWS, Microsoft Azure, and Google Cloud use virtualization to deliver more cheaper and scalable solutions and make it easy for businesses to manage data and applications in the cloud.

Fig2. Virtualization in Cloud Computing

4. SERVERVIRTUALIZATION VS CONTAINERIZATION

Server virtualization and containerization are two different approaches used to deal with virtualization, each of them has their own advantages and usage requirement. Server virtualization involves running distinct virtual machines (VMs) on a real-life server, where each VM operates besides its own full operating system (OS). This provides strong privacy, as every VM is independent, and allows running different OS types on the same hardware. But this approach also results in higher resource overhead, as each VM requires significant CPU, memory, and storage resources for its full OS. On the other hand, Containerization operates at the OS level, where applications and their dependencies are kept into isolated containers that share the host system's kernel. Containers are light in weight, accurate, and runs much faster compared to VMs, as they do not demand separate OS to run. While containers offer higher performance and resource availability, they provide slightly weaker isolation since they depend on the host OS kernel, making them more chances of getting security risks if they are not managed properly. Containerization is best

suitable option for cloud-native applications, microservices, and environments that require scalability and faster deployment. It also excels in portability, as containers can easily be moved between different locations as well as different environments.

5. VIRTUALIZATION IN DATA CENTERS

In data centers, virtualization aims on managing the physical infrastructures, enhancing the resource utilization, and increasing the operational efficiency using various virtualization technologies. It involves creating the virtual versions of the physical servers, storage devices that are being used in virtualization processes, and all the networking components that allows the data centers to run distinct workloads by using a smaller number of physical resources. The most commonly used form of virtualization in data centers is Server Virtualization, where it contains a hypervisor that enables multiple virtual machines (VMs) to operate on a single physical server without any difficulty. This leads to more optimal and efficient use of various hardware resources, reducing the need for physical servers, and also lowers the energy consumption and the cooling cost of the physical infrastructure, that ultimately makes the data centers more energy-efficient and cost-effective. Two other critical aspects in Virtualization in Data Centers are storage virtualization and disaster recovery.

6. TYPES OF VIRTUALIZATION

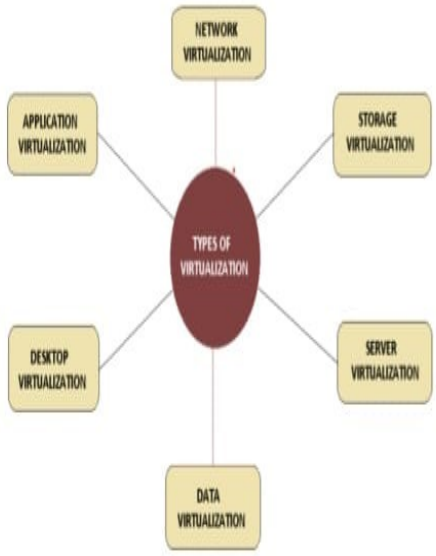

Fig3. Types of Virtualizations

i. Network Virtualization

The ability to run multiple virtual networks with each has a separate control and data plan. It co-exists together on top of one physical network. networks—logical switches, routers, load balancer, Virtual Private

Network Virtualization is a process of logically grouping physical networks and making them operate as single or multiple independent networks called Virtual Networks.

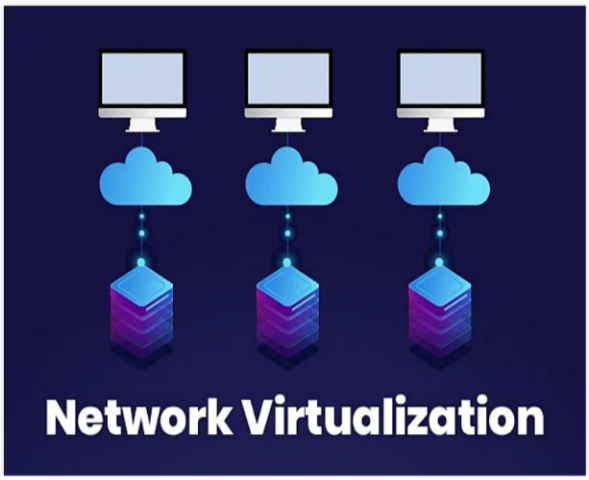

Fig4. Network Virtualization

ii. Application virtualization

Application virtualization helps a user to have remote access of an application from a server. The server stores all personal information and

other characteristics of the application but can still run on a local workstation through the internet.
Using application virtualization software, IT admins can set up remote applications
on a server and deliver the apps to an end user's computer.

Fig5. Application Virtualization

iii. Desktop virtualization

Desktop virtualization allows the users' OS to be remotely stored on a server in the data center. It allows the user to access their desktop virtually, from any location by a different machine. Users who want specific operating systems other than Windows Server will need to have a virtual desktop. Main benefits of desktop virtualization are user mobility, portability, easy management of software installation, updates, and patches.

Fig6. Desktop Virtualization

iv. Storage virtualization

Storage virtualization is an array of servers that are managed by a virtual storage system. It makes managing storage from multiple sources
to be managed and utilized as a single repository. Storage virtualization is the pooling of physical storage from multiple storage devices into what appears to be a single storage device or pool of available storage capacity that is managed from a central console.
The technology relies on software to identify available storage capacity from
physical devices and to then aggregate that capacity as a pool of storage that can be
used by traditional architecture servers or in a virtual environment by virtual machines.

Fig7. Storage Virtualization

v. Data virtualization

This is the kind of virtualization in which the data is collected from various sources and managed that at a single place without knowing more about the technical information like how data is collected, stored & formatted then arranged.
that data logically so that its virtual view can be accessed by its interested people and stakeholders, and users through the various cloud services remotely. Many big giant companies are providing their services like Oracle, IBM, C data, etc. It can be used to performing various kind of tasks such as:
Data-integration
Business-integration
Service-oriented architecture data-services
Searching organizational data.

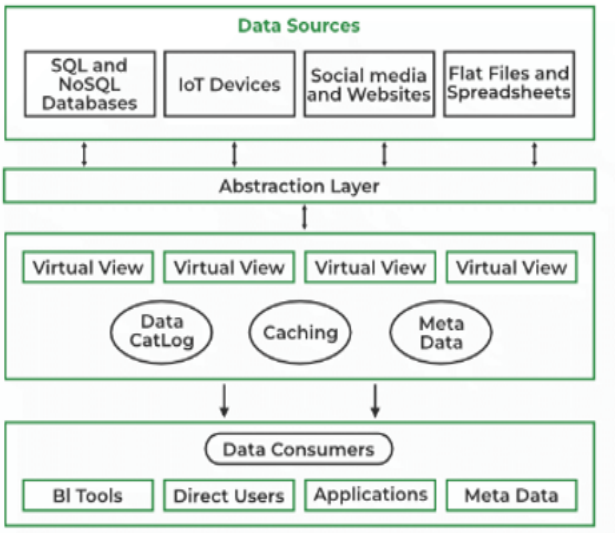

Fig8. Data Virtualization

vi. Server virtualization

process of dividing a physical server into multiple

unique and isolated virtual servers by means of a software application. Each virtual

server can run its own operating systems independently. This is a kind of virtualization in which masking of server resources takes place. Here, the central-server (physical server) is divided into multiple different virtual servers by changing the identity number, processors. So, each system can operate its own operating systems in isolate manner.

Fig9. Server Virtualization

7. ADVANTAGES OF VIRTUALIZATION

i. Cost :- Using a virtualization system is actually cheaper due to the fact that it doesn't require any hardware component. therefore IT infrastructures consider it inexpensive because there is no investment involved in to create on site resources or any separate areas space. the only thing that you need is the license or the access from the third party who maintains all servers.

ii. Efficiency :- Virtualization also allows automatic update to the hardware and software by installing on their third party provider. Due to this IT professionals do not need to spend money for individuals and corporation. in addition to that virtualization reduces the load of resource management for facilitating the efficiencies the virtual environment.

iii. Uptime :- virtualization has the capability to prevent unnecessary downtime by making use of resources the maximum. Even budget friendly virtualization services can offer an uptime of almost 99.9%today. This can be especially beneficial for small businesses which data for testing.

iv. 4.Deployment :- deploying resources are considerably faster when using the virtualization technology. Time spent on creating local network or setting up physical machines can be saved significantly. Thus the only thing that you need is at least a single access to the virtual environment. And also virtual machine deployment is more simple than deployment physical version.

v. 5.Energy savings :-Using virtualization literally means that the system is more energy efficient since there is no hardware or software that is being used. This helps the companies to neglect the cooling cost of the data center which can significantly reduce the cost of utility bills. Microsoft it is more environment friendly because it reduces carbon footprint.

8. DISADVANTAGES OF VIRTUALIZATION

i. Implementation :- Although is mentioned that the virtualization is highly cost effective still it needs more investment when it comes

to implementation. This is because at some instance the hardware and software are required which means that device needs to be purchased to make the virtualization possible. This can mainly effect the providers of virtual environment. However is one time investment which long term benefits.

ii. Limitations :- virtualization does involves many limitations. Every server and application out there is not virtualization compatible. Hence some of the IT infrastructure of the organization will not be supporting the virtualization solutions. Moreover there are many vendors who has stopped supporting them. For overcoming this individuals and organization needs to have a hybrid system.

iii. Security :- Data is a crucial aspect of every organization. Data security is often question in a virtualization environment since the server is managed by managed by the third party providers. Therefore it is important to choose the virtualization solution wisely so that can provide adequate protection.

iv. Availability :- Availability is another important aspect of an organization the data needs to be connected for a prolonged period of time. If not the organization will be going to loose the competition in the industry. The issue with the availability can come from the virtualization servers. The virtualization servers has the tendency to go offline hence the websites.

CONCLUSION

In conclusion, virtualization is growing as a foundation of modern IT infrastructures, driving efficiencies, scalability, and low-cost models across various sectors. Through the conversion of physical hardware to virtual hardware, virtualization enables organizations to maximize resource utilization and improve operational flexibility. Whether through server virtualization, storage virtualization, or network virtualization, these technologies are growing as a solid foundation for cloud computing, enabling the dynamic and efficient usage of resources.

The ongoing development in virtualization technologies, including advancements in automation, and security, make sures to further enhancements in boundaries of virtualized environments. As businesses continue to adapt to fast-changing technologies, virtualization will always be going to be used as an essential tool in optimizing IT operations, supporting new ideas, and supporting digital transformation.

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