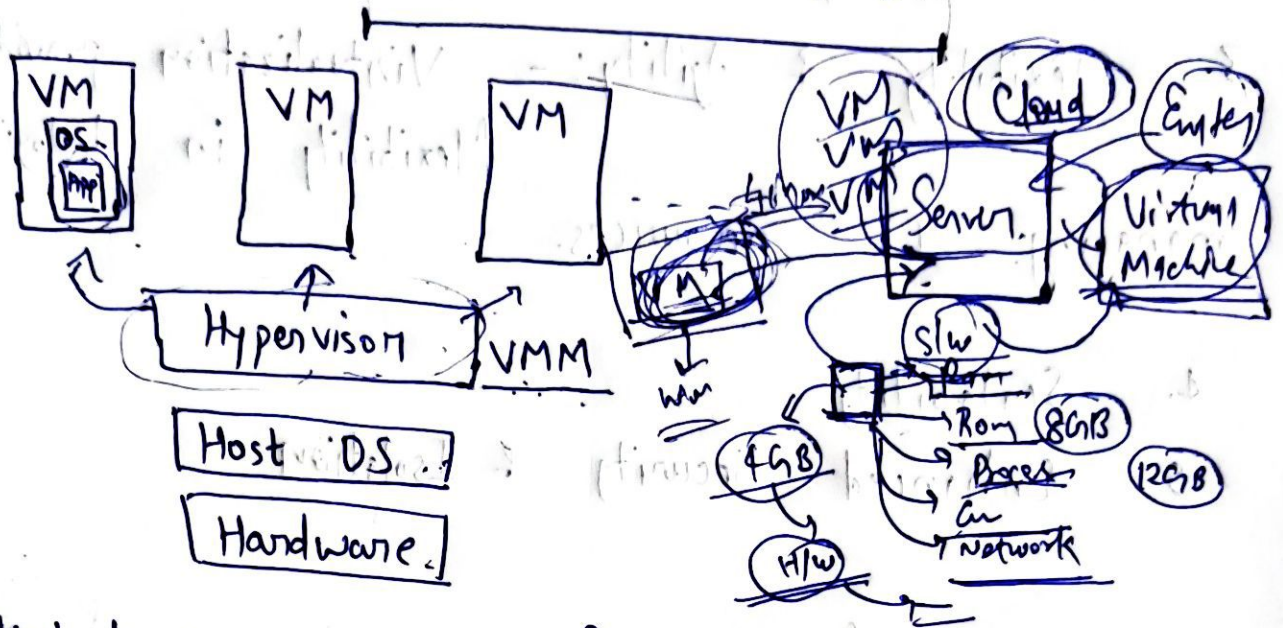


Virtualization ✓



Virtualization is a fundamental technology in CC that allows for efficient utilization of computing resources. It involves creating virtual versions of physical resources such as servers, storage devices & networks.

→ These virtual resources can be allocated, managed & used by multiple users on applications simultaneously.

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→ Virtualization is a key component of IaaS model.

Benefits :- Improved Resource Utilization :- It

allows for consolidation of multiple VMs onto a single physical server.

Video tutorials are available on channel

2. Cost Reduction

3. Flexibility & Agility :- Virtualization provides flexibility in deploying & managing IT resources.

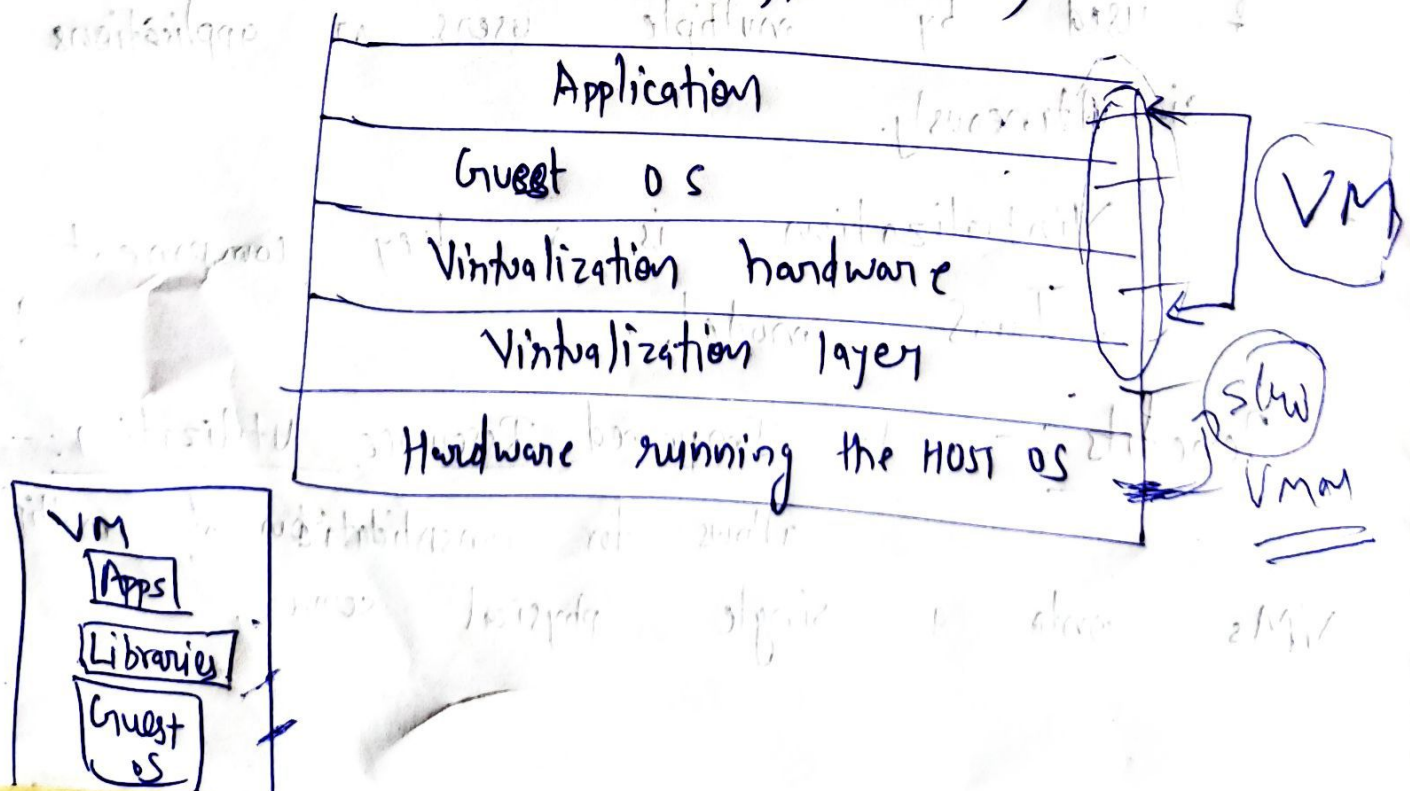
4. Scalability

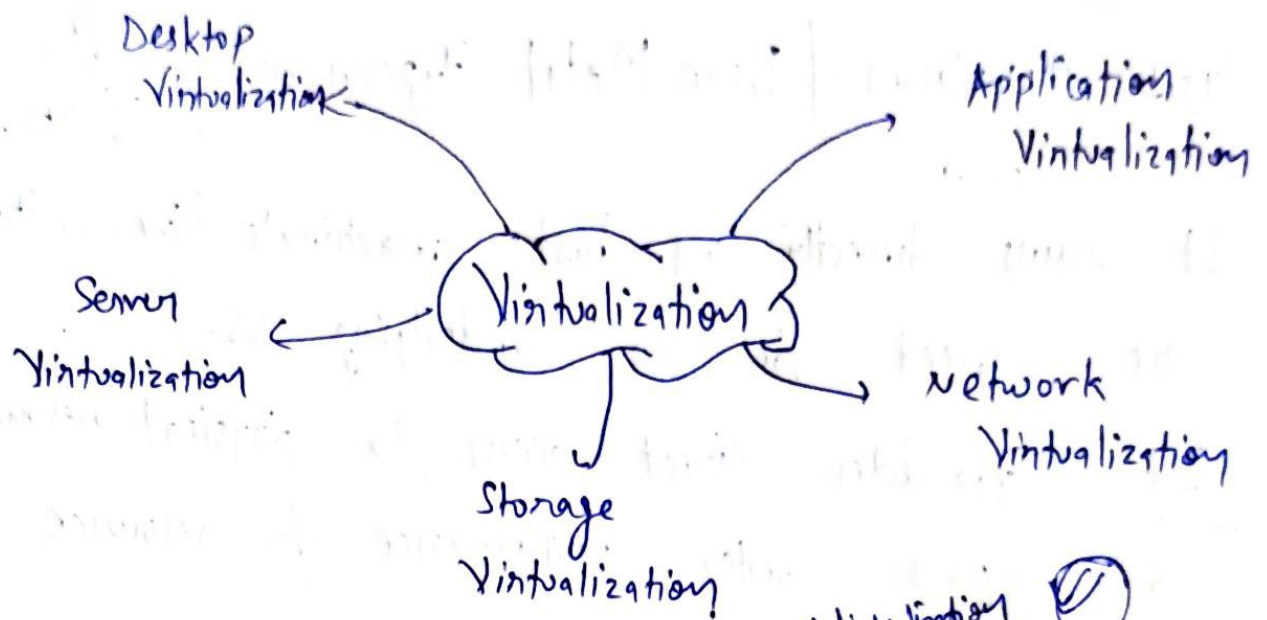
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5. Enhanced Security & Isolation

Level of virtualization:-

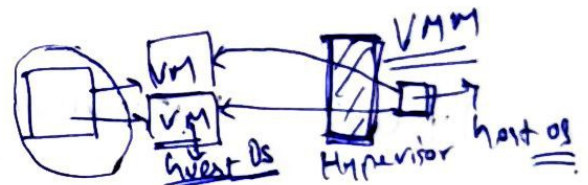
Virtualization makes possible to manage user applications & OSs which runs on same h/w but independent to host OS. This is done by adding additional sw called virtualization layer (VMM or hypervisor).



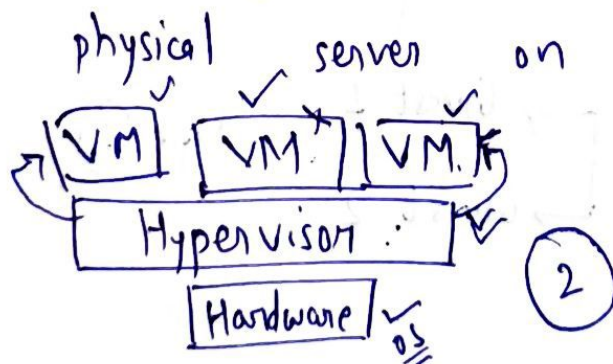


Hypervisor Virtualization
playlist

Hypervisor ✓



→ Hypervisor is also known as virtual machine monitor (VMM) is slw on firmware layer that enables the virtualization of physical computing resources. It's responsible for managing & controlling VMs running on physical server on host machine.



- Resource Allocation ✓
- Isolation ✓
- Hardware Emulation ✓
- VM Management
- Performance Optimization

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* Type 1 Hypervisor / Bare Metal Hypervisor! —

It runs directly on host machine's h/w without the need for an underlying OS.

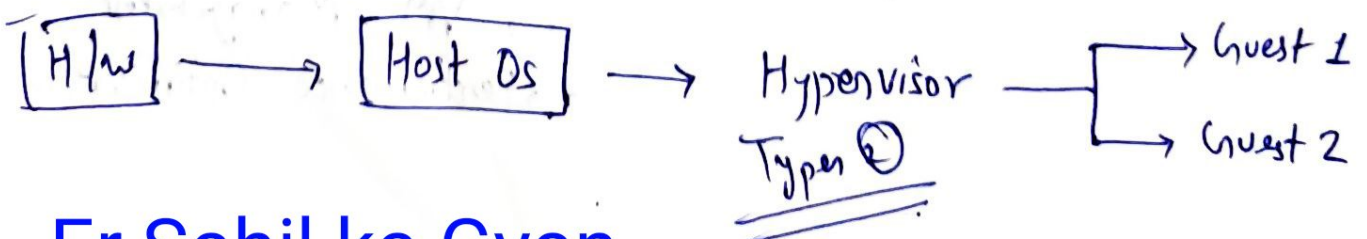
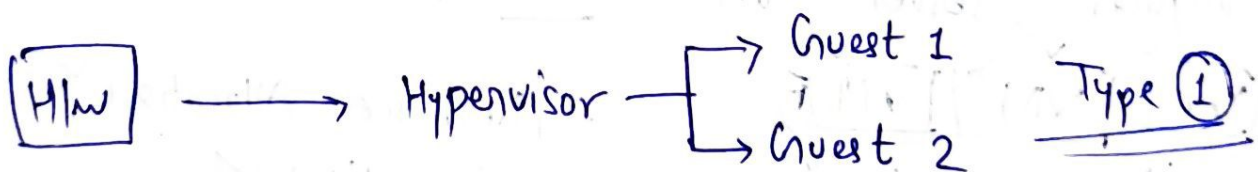
It provides direct access to physical resources & offers better performance & resource utilization.

Ex — VMware ESXi, Microsoft Hyper-V & Xen.

* Type 2 Hypervisor / Hosted Hypervisor! —

It runs as a sw layer on top of an existing operating system. It requires host machine to have an underlying OS that provides device drivers & manages h/w interactions.

Ex — VMware Workstation, Oracle VirtualBox.



★ VMware :- (Monolithic hypervisor)
(Type 1)

This assembles directly b/w physical h/w & OS.



★ Xen :-

An open source hypervisor program.

It is a micro-kernel hypervisor which implements only the mechanisms. It does not contain any device drivers.

It just provides a mechanism to guest as for getting direct access to physical devices.

Control I/O
(Domain 0)
Application

Domain 0

Guest
Domain

Application

XenoLinux

Guest
Domain

Application

XenoWindows

Xen Hypervisor

H/w devices

Architecture of Xen.

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Virtualization of CPU, Memory, I/O devices,

→ To perform virtualization the Virtual machine & OS runs in applications installed in virtual machine.
To save processor processing is done by Hardware.



Hardware Virtualization:

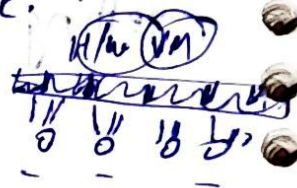
Multiple processes runs in parallel in modern OS & processors. The crash occurs when different processes from ~~di~~ multiple processor access the hardware by using no any protection rule.

②

mode: —

→ User mode ✓

→ Supervisor mode ✓



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CPU Virtualization: —

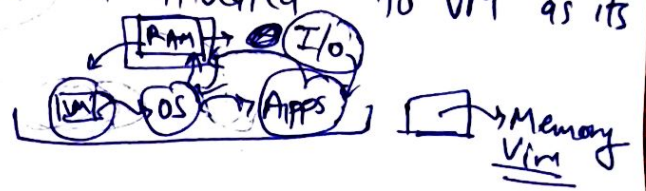
VM is a copy of existing system & instructions of it.

are executed on host processor in native mode.

Unprivileged instructions of VM runs directly on host machine for higher efficiency.

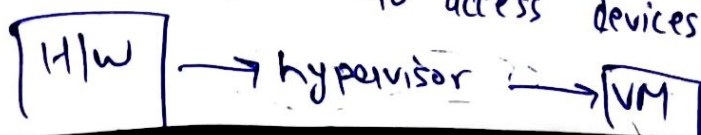


Memory Virtualization:- The traditional OS supports virtualization by making page tables. All modern CPUs contains memory management unit (MMU) & translation look-aside buffer (TLB) to perform virtualization. The memory of the physical system is virtualized & allocated to VM as its physical memory.



I/O Virtualization:- I/O Virtualization manages I/O requests b/w VM & the physical machine. There are ③ ways to implement I/O Virtualization:-

- Full device emulation \Rightarrow It provides emulation of well known real world devices.
- Para-virtualization \Rightarrow Contains frontend & backend driver.
 - (split driver)
 - (I/O requests of virtual OS) \downarrow
 - (manages real I/O devices)
- Direct I/O virtualization \Rightarrow It allows virtual machine to access devices directly.



Virtual Cluster & Resource Management:-

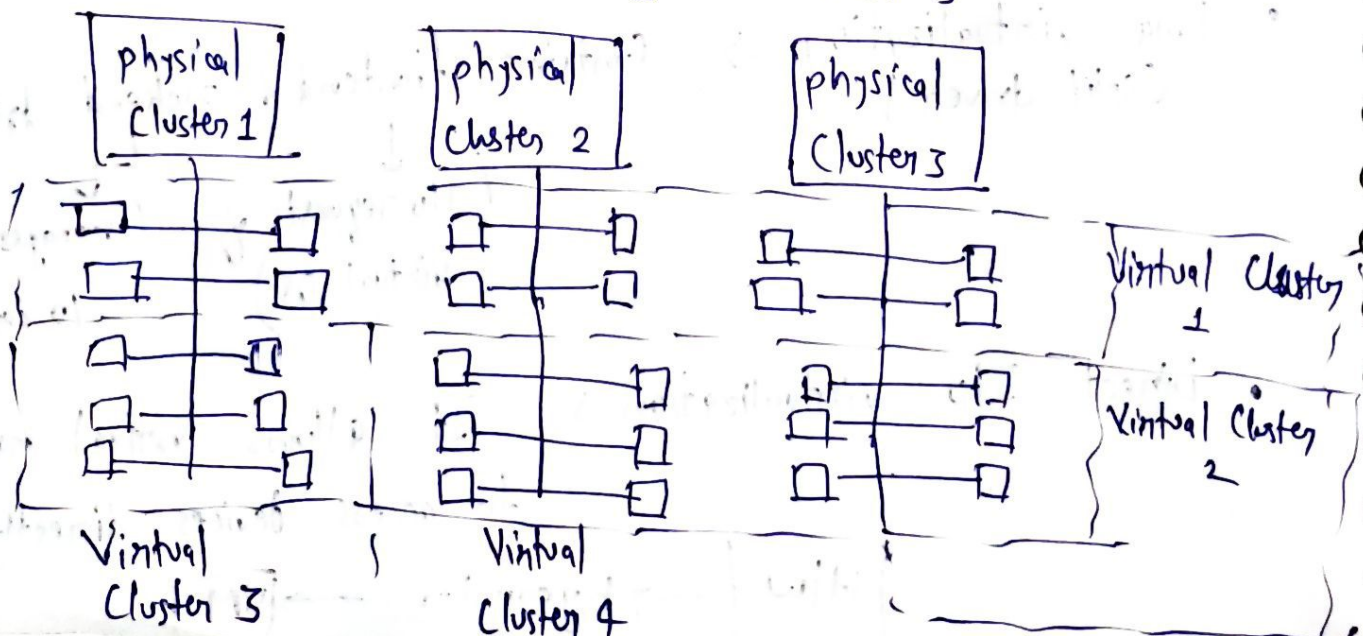
A physical cluster is a collection of physical machines interconnected by a physical network such as a LAN. Here we will study about the 3 critical design issues of virtual clusters.

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- Live migration of VMs
- Memory & File migrations
- Dynamic deployment of virtual clusters

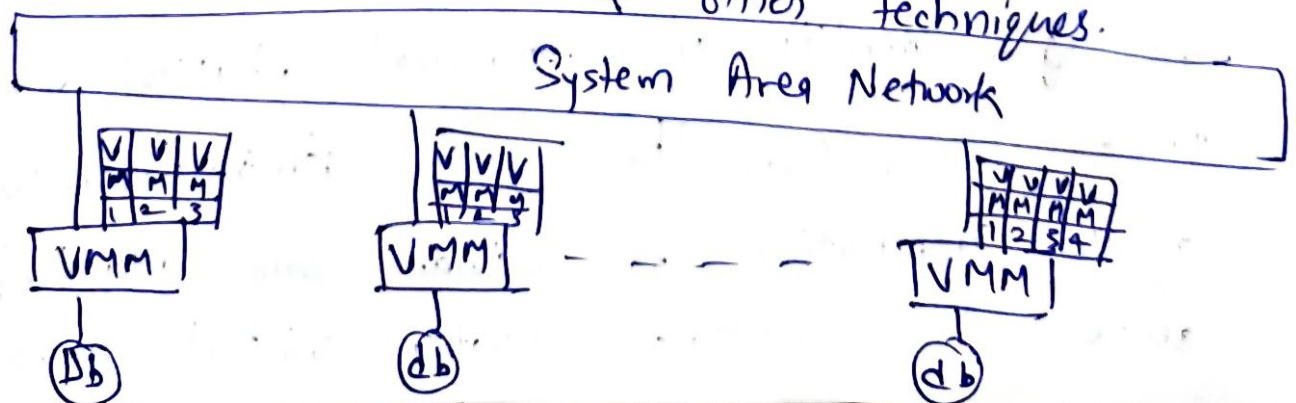
traditional VM
↓
manually Conf.

Virtual clusters are built with VMs installed at distributed servers by using or more physical clusters



The provisioning of VMs to a virtual cluster is done dynamically & which have the following interesting properties:

- The virtual cluster nodes can be either on physical machine or VMs.
- Multiple VMs running with different OS can be deployed on same physical node.
- A VM runs with guest OS & which is totally different from host OS.
- The purpose of using VMs is to combine multiple functionalities on same server. This will provide huge server utilization & application flexibility.
- This involves virtual cluster deployment, monitoring & management over large-scale clusters as well as resource scheduling, load balancing, server consolidation, fault tolerance & other techniques.



High Performance Virtual Storage:-

Template VM can be distributed to several physical hosts within cluster to customize other VMs.

There are 4 steps to involve deploy a group of VMs onto a target cluster.

- Prepare the disk image
- Configure the VMs
- Choose the destination nodes
- Execute VM deployment command on every host.

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Virtualization of Server, Desktop & Network:-

Virtualization of server different types of virtualization such as client, storage, desktop & network virtualization.

→ Server virtualization is a process of virtualization host server resources including no. & identity of individual physical servers, processors & OSs. The server administrator uses a s/w application to divide one physical server into multiple isolated virtual servers.

The virtual servers provide an abstraction of a complete independent server to server users.

Virtual Machine ✓

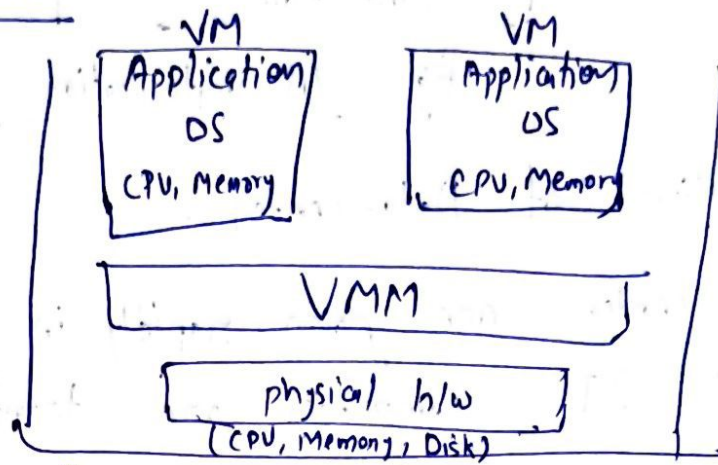


fig: - Server Virtualization

② types of technologies are used for server virtualization

- Hardware virtualization: virtualizes the server h/w.
- OS virtualization: virtualizes the applications which runs over physical h/w.

Hardware virtualization ⇒ Virtualization layer runs immediately on h/w & divides physical machine into several VM or partitions by using guest OS. (Type 1 Virtualization)

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OS virtualization ⇒ Server virtualization is also known as OS based virtualization. (Type 2 virtualization)
OS vir. creates virtual OS for a single partition of a h/w. The virtual OS created by OS virtualization are also called containers.

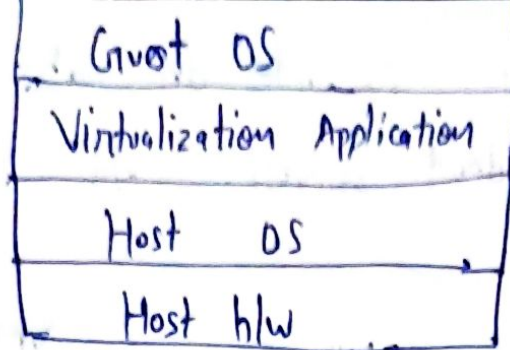


fig:- OS virtualization

Virtualization of Data-center:-

Data centers are grown rapidly in recent years & all major IT companies are transferring their resources into new data centers.

So virtualization is • increasing mobility, reducing maintenance & increasing the number of virtual clients.

Server Consolidation in Data Centers:-

In data centers a huge amount of heterogeneous workloads runs on servers at many times.

Heterogeneous workloads is divided into

2 categories:-

- Chatty workloads :- (burst at some point & return to silent state at some other point)
Ex - (web video, exam results)
- Non - interactive workloads :- The workload do not require efforts to make progress after they are submitted.
Eg - high performance computing,

Virtual Storage Management:-

Storage Virtualization is used for aggregation & repartitioning of disks at very coarse time scales for use in physical machines.

→ Virtual storage contains storage maintained by VMMs & guest OS.

The data stored here is classified into 2 categories:

VM images : special to virtual env.

Application data : All other data which is same as data in host OS.

Encapsulation & isolation aspected in system virtualization.



→ Storage in guest OS is done through real disk while the guest OS can't access the hard disk directly.

→ Some guest OS contains hard disk where there VMs are running on a single physical machine. So, storage management in VMM is more complex than that of guest OS.

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