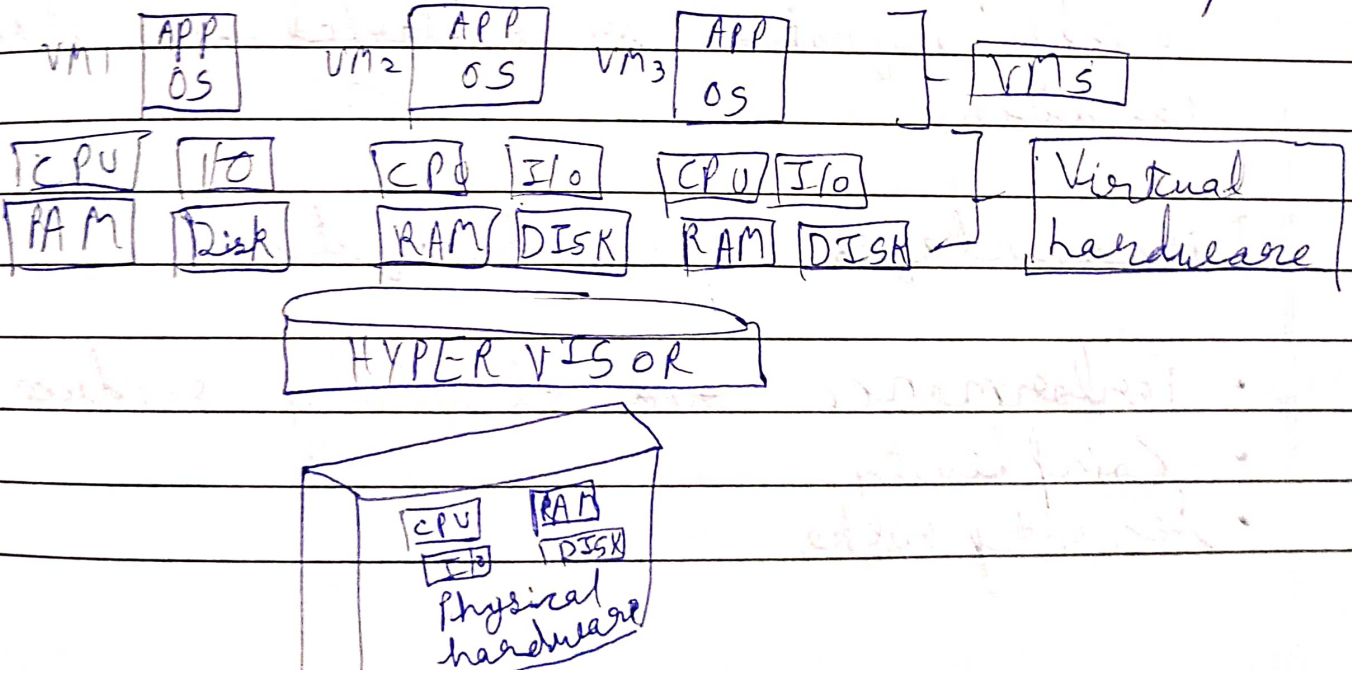
VIRTUALIZATION

It is a technique which allows to share single physical ~~instance~~ resource among multiple organizations or tenants.

All virtual resources will work independently



The machine on which the virtual machine is created is known as host machine, whereas each virtual machine is refferred as a guest machine.

Traditional setup	Virtualized setup
high effort	low effort

Advantages of Virtualization

- Resource Utilization
- lowers the cost of ~~IT~~ physical Infrastructure
- remote access
- High availability
- Scalability
- Isolation : Each VM operates independently
- Reliability : If one VM stops it doesn't affect others
- Security and reduces cost on maintenance
- Makes it possible to run multiple applications and various operating systems on the same SERVER at the same time.

In case of physical hardware failure VMs can be quickly migrated or restarted on alternate hardware.

Disadvantages of Virtualization

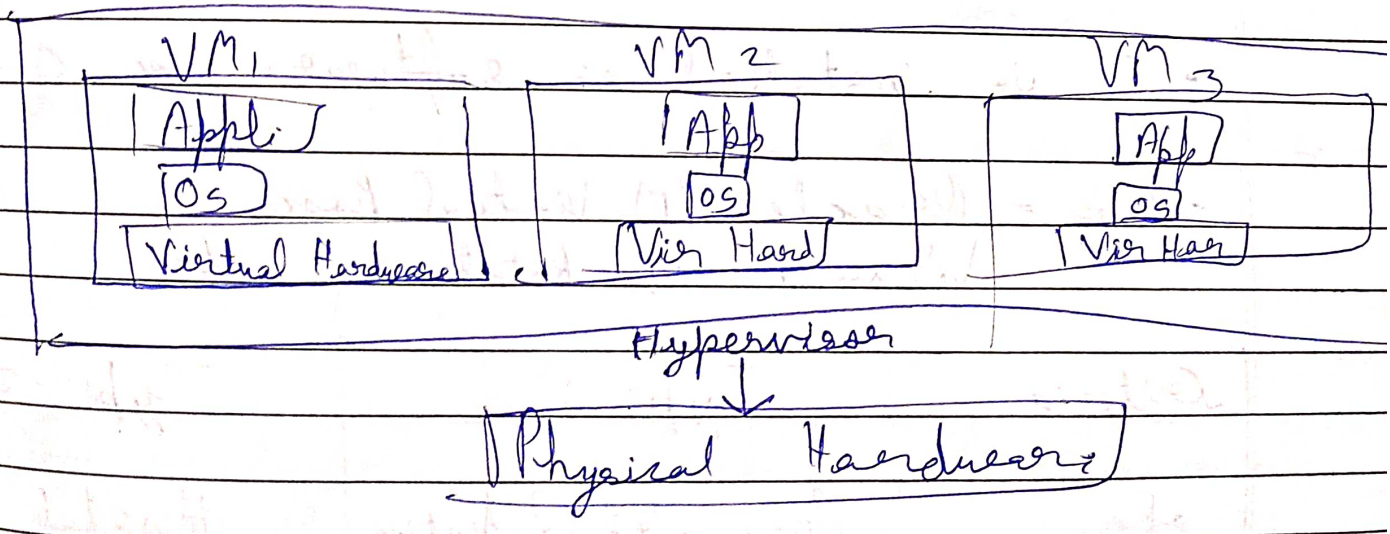
- Performance ~~not~~ slightly reduce.
- Complexity
- Security risks.

- Single point of failure
- licensing costs
- Vendor lock-in

This Virtual machine is managed by a software or firmware which is known hypervisor. VMM (Virtual Machine Monitor)

Virtual Machine is a software which is emulation of a physical computer but in real is a part of host computer

The hypervisor is a firmware or low-level program that acts as a VM Manager
- It sits between the hardware and the operating system.
- It assigns the amount of time and way the applications and operating system ~~have~~ can use the processor and other resources



Example - VMware vsphere / ESXi, Microsoft Hyper-V, Citrix Hypervisor, Oracle VM VirtualBox, etc.

Why hypervisor / benefits of hypervisor :-

- Hardware Abstraction
- Resource Allocation
- Isolation
- Management
- Support
- migration

Emotions
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There are two types of Hypervisor

Type 1 Hypervisor (Bare-metal Hypervisor)

- It runs directly on the physical hardware of server and does not need host operating system to interact with hardware and devices.
- It is installed directly onto the physical hardware which offers high performance.
- Ex - VMware ESXi, Hyper-V, Citrix Hypervisor

Type 2 Hypervisor (Hosted Hypervisor)

- It runs on host Operating system. This rely on the host operating system for hardware and device access.
- It is installed as software on OS.
- Ex - Oracle VM Virtual Box, VMware Workstation, etc

Criteria	Type 1	Type-2
aka	Bare Metal & Native	Hosted
Virtualization	Hardware Virt.	OS Virt.

operation	Guest OS and applications run on the hypervisor	Runs as an application on the host OS
Scalability	Better Scalability	Not as much because of its resilience on the underlying OS.
System Independence	Has direct access to hardware along with Virtual Machines it hosts	Not allowed to directly access the host hardware and its resources.
Performance	Higher performance as there is no middle layer	Comparatively has reduced rate as it runs with extra overhead
Security	More Secure	Less, as any problem in the OS affect the entire system

★ Different methodologies or techniques to achieve virtualization.

① full Virtualization

The hypervisor creates a complete virtual replica of the physical hardware.
Guest operating systems running within virt. mach. are unaware that they are virtualized and interact with the virtual hardware as if it is physical hardware.

VM1 VM2 Host Hard

The hypervisor translates the instructions from guest operating system to the virtualized hardware.

Ex - VMware ESXi, Hyper-V, Xen, etc.

② Partial Virtualization

It is a technique in which special virtualization features or extensions are installed in CPU.

In instead of completely emulating the hardware, VMs share CPU features except some specified features which are provided to user using containers.

Hence Partial is also known as containerization. ~~or host of hypervisor~~.

Ex - VMware Workstation, Virtual Box, KVM, etc.
Ex - Docker.

③ Para Virtualization

It is a technique that involves modifying the guest operating system to be aware of the virtualized environment.

Guest operating systems are modified to use special hypercall or hyper call - like interface to communicate with the hypervisor and access virtualized hardware directly.

Guest operating system is optimized to reduce the hypervisor overhead.

Ex - Xen, LXC, etc.

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