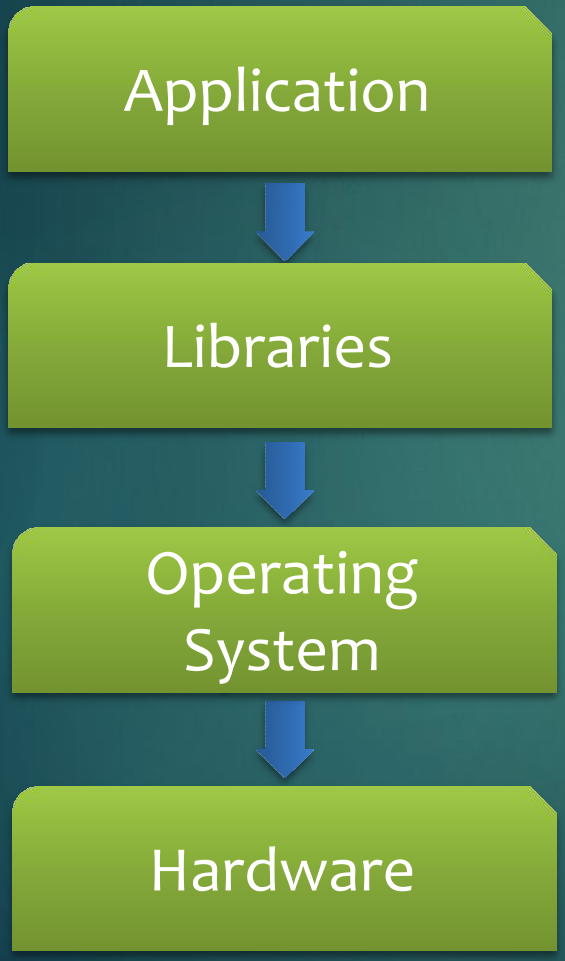
Virtualization for Cloud Computing

CLOUD COMPUTING

- On demand provision of computational resources (Infrastructure, Platform, Software).
- Requires high availability of resources and optimum use.
- Virtualization is the enabling technology and creates virtual machines that allows a single machine to act as if it were many machines.
- Benefits of virtualization for cloud computing: Reduces capital expenses and maintenance costs through server consolidation, reduces physical space needed in data centers. Resource Management, Migration, Maintainability, High availability and Fault tolerance are other benefits.
- Virtualization is implemented using hypervisors.

VIRTUALIZATION

Machine Stack showing virtualization opportunities



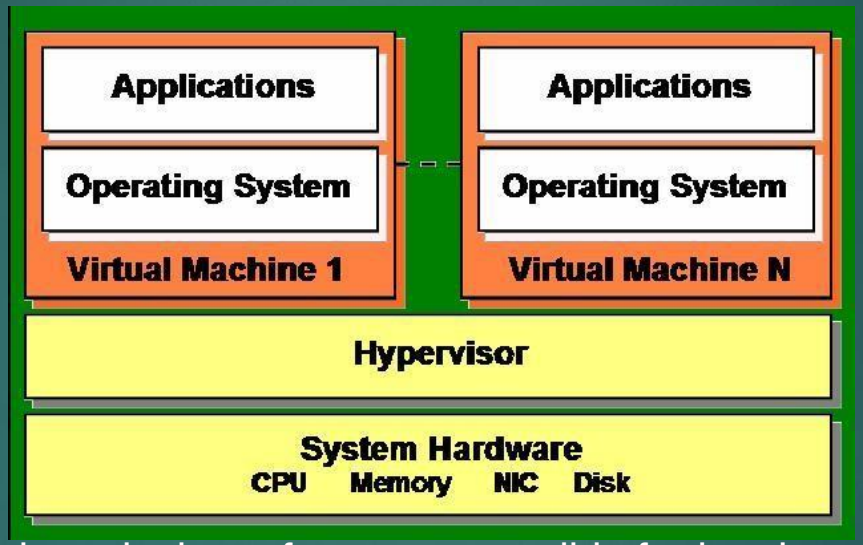
- Creation of a virtual version of hardware using software.
- Runs several applications at the same time on a single physical server by hosting each of them inside their own virtual machine.
- By running multiple virtual machines simultaneously, a physical server can be utilized efficiently.

Primary approaches to virtualization

- Platform virtualization Ex : Server
- Resources virtualization Ex : Storage, Network

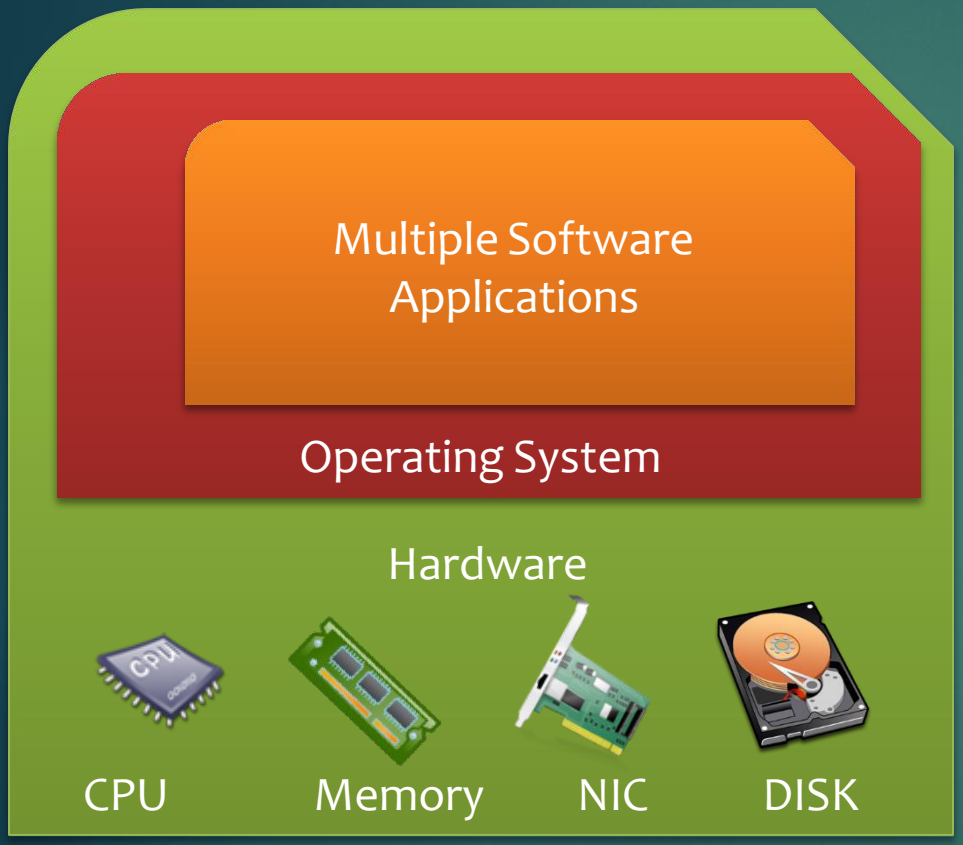
HYPERVISOR

- Hypervisor plays an important role in the virtualization scenario by virtualization of hardware. It provides support for running multiple operating systems concurrently in virtual servers created within a physical server.



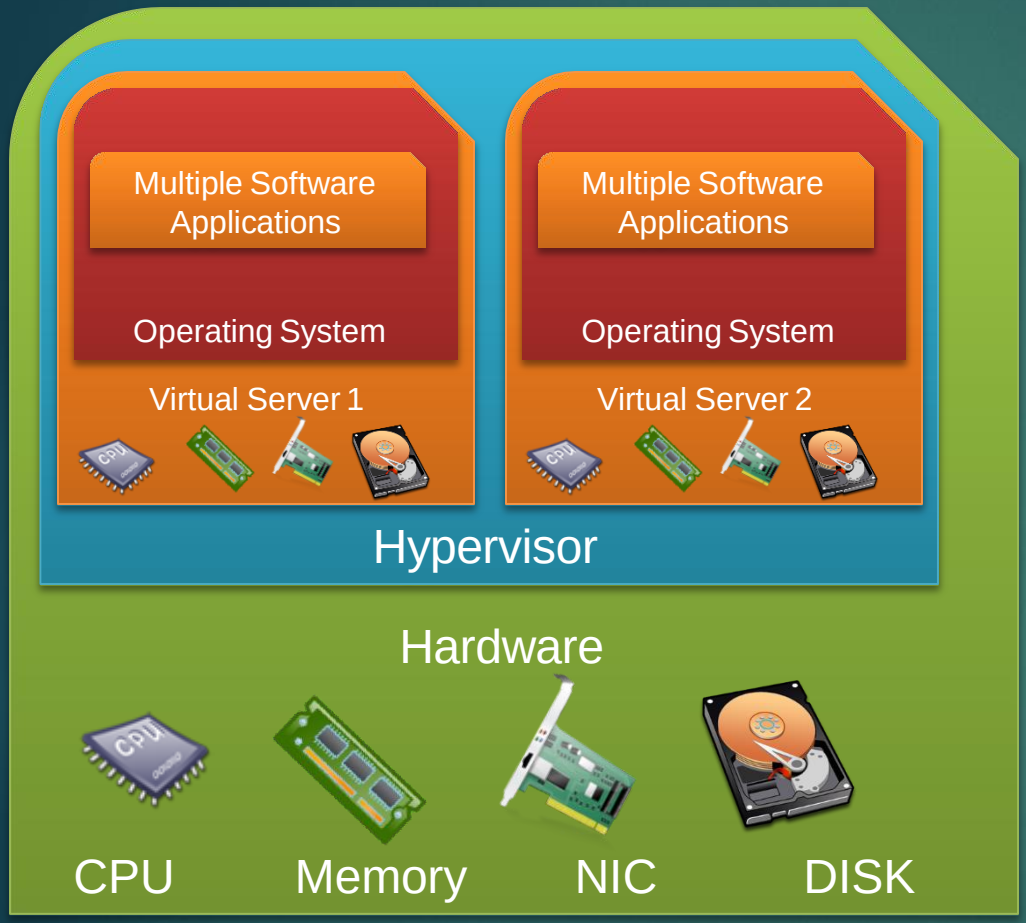
- The virtualization layer is the software responsible for hosting and managing all VMs. The virtualization layer is a hypervisor running directly on the hardware.
- Example: VMWare, Xen, KVM.

SERVER WITHOUT VIRTUALIZATION



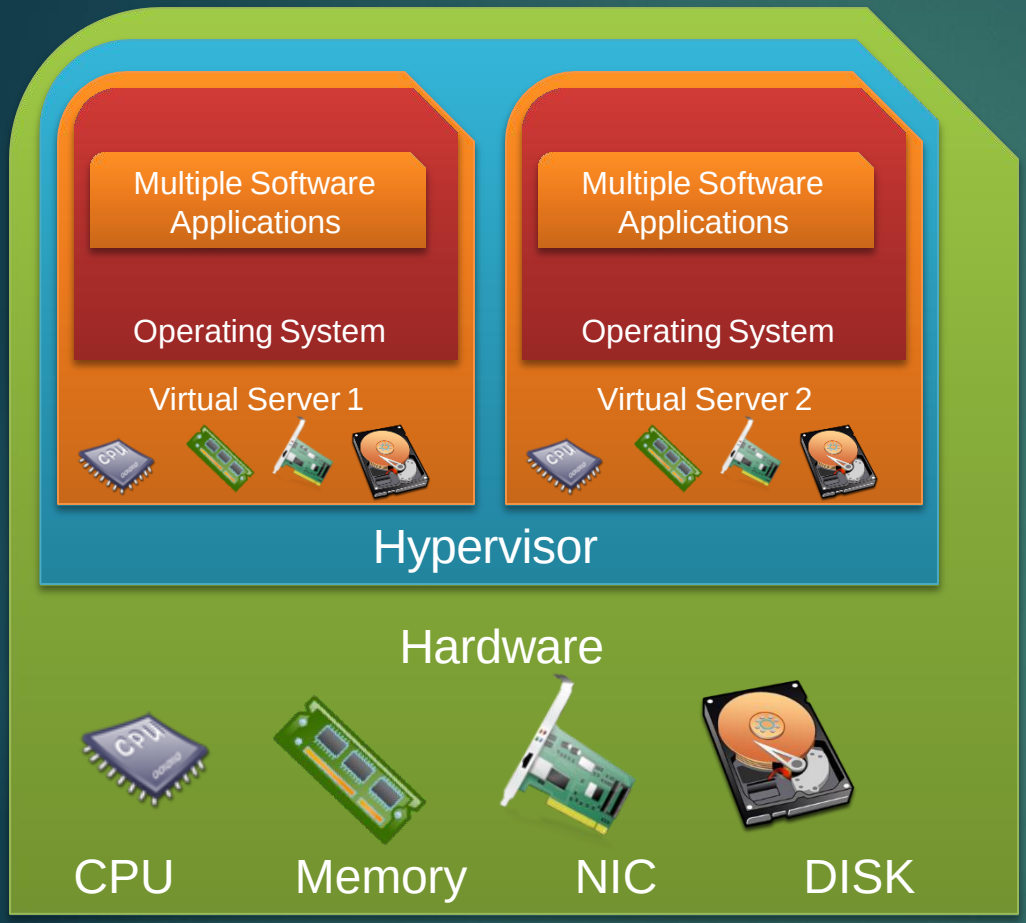
- Only one OS can run at a time within a server.
- Under utilization of resources.
- Inflexible and costly infrastructure.
- Hardware changes require manual effort and access to the physical server.

SERVER WITH VIRTUALIZATION



- Can run multiple OS simultaneously.
- Each OS can have different hardware configuration.
- Efficient utilization of hardware resources.
- Each virtual machine is independent.
- Save electricity, initial cost to buy servers, space etc.
- Easy to manage and monitor virtual machines centrally.

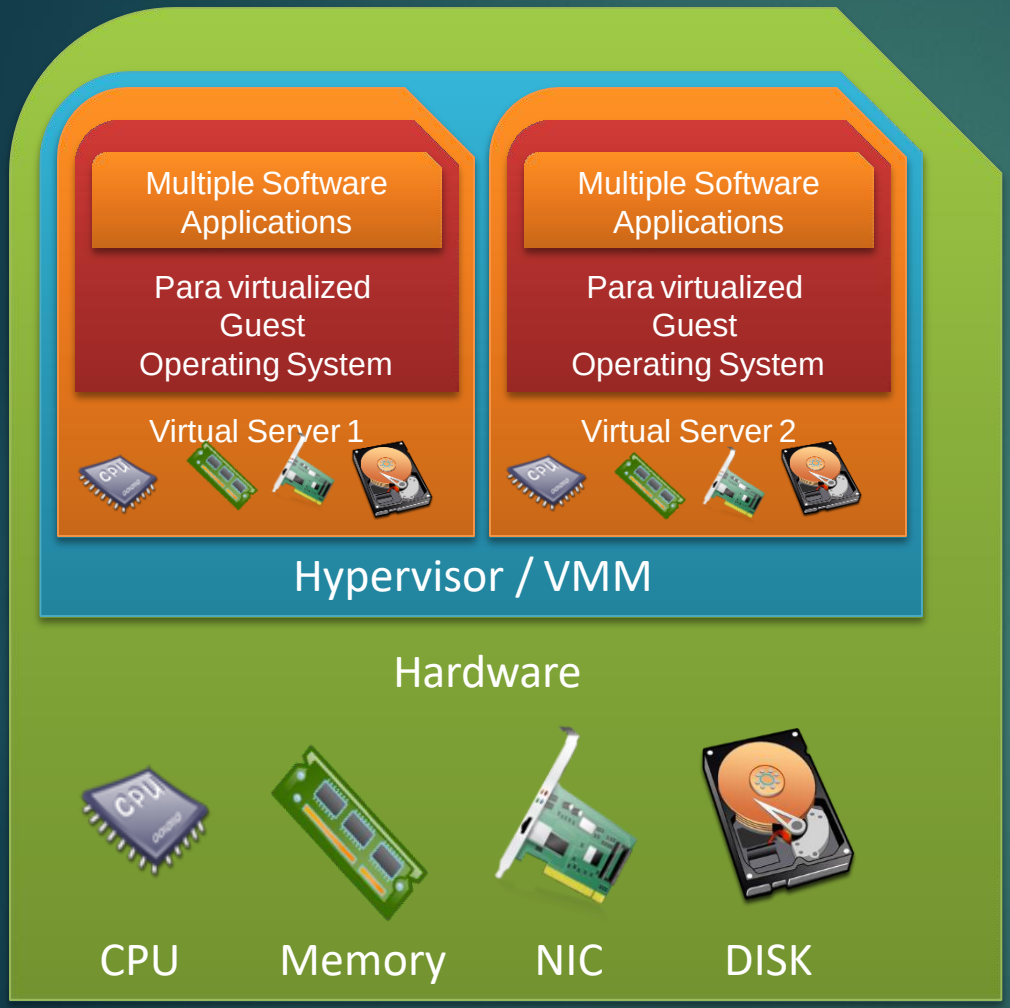
HYPERVISOR TYPE



Full virtualization

- Enables hypervisors to run an unmodified guest operating system (e.g. Windows 2003 or XP).
- Guest OS is not aware that it is being virtualized.
- E.g.: VMware uses a combination of direct execution and binary translation techniques to achieve full virtualization of server systems.

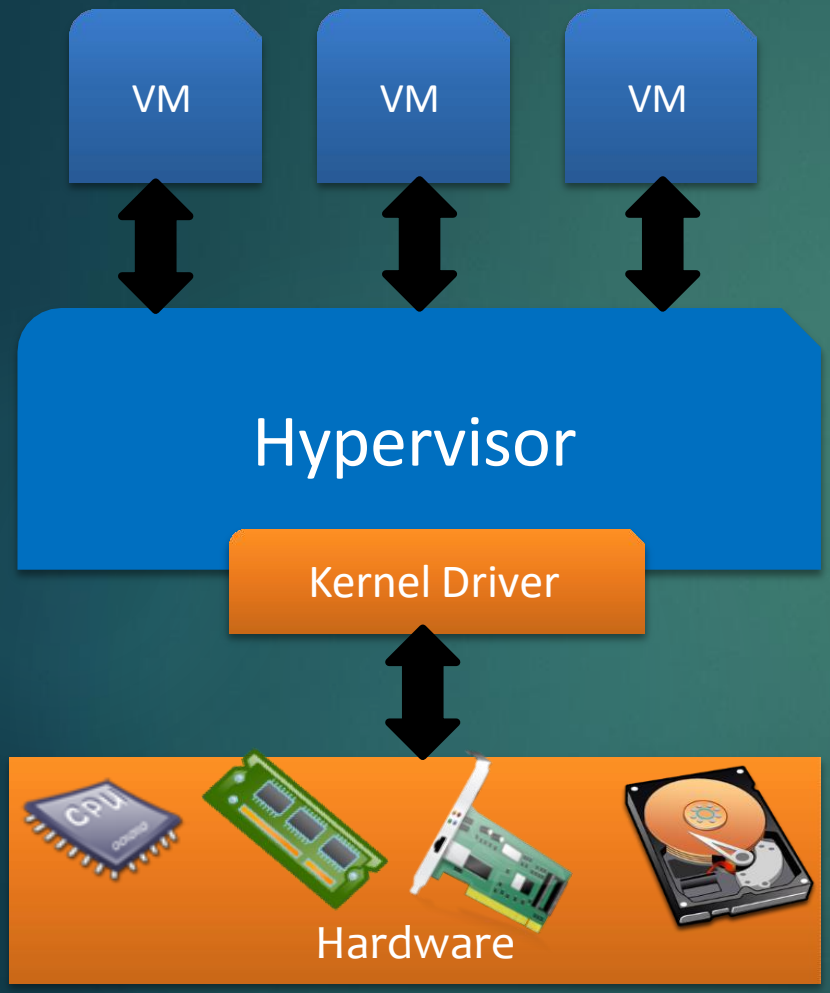
HYPERVISOR TYPE



Para virtualization

- Involves explicitly modifying guest operating system (e.g. SUSE Linux Enterprise Server 11) so that it is aware of being virtualized to allow near native performance.
- Improves performance.
- Lower overhead.
- E.g.: Xen supports both Hardware Assisted Virtualization (HVM) and Para-Virtualization (PV).

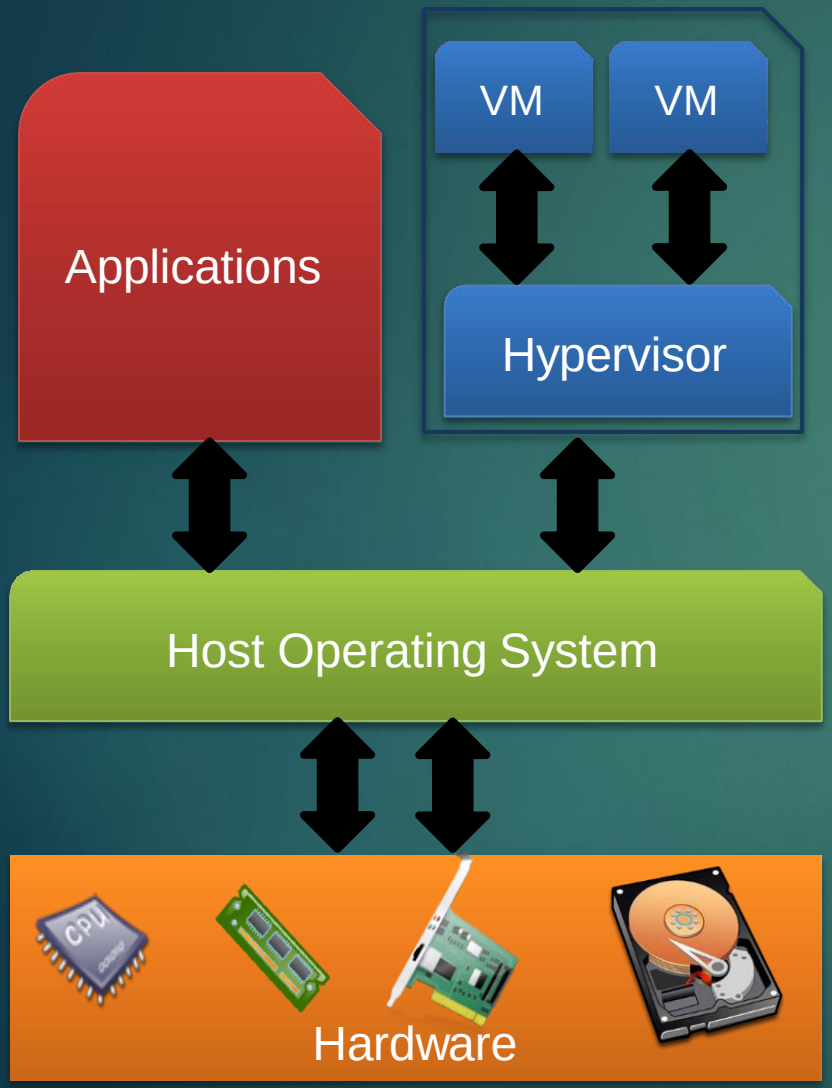
HYPERVISOR IMPLEMENTATION APPROACHES



Bare metal Approach

- Type I Hypervisor.
- Runs directly on the system hardware.
- May require hardware assisted virtualization technology support by the CPU.
- Limited set of hardware drivers provided by the hypervisor vendor.
- E.g.: Xen, VMWare ESXi

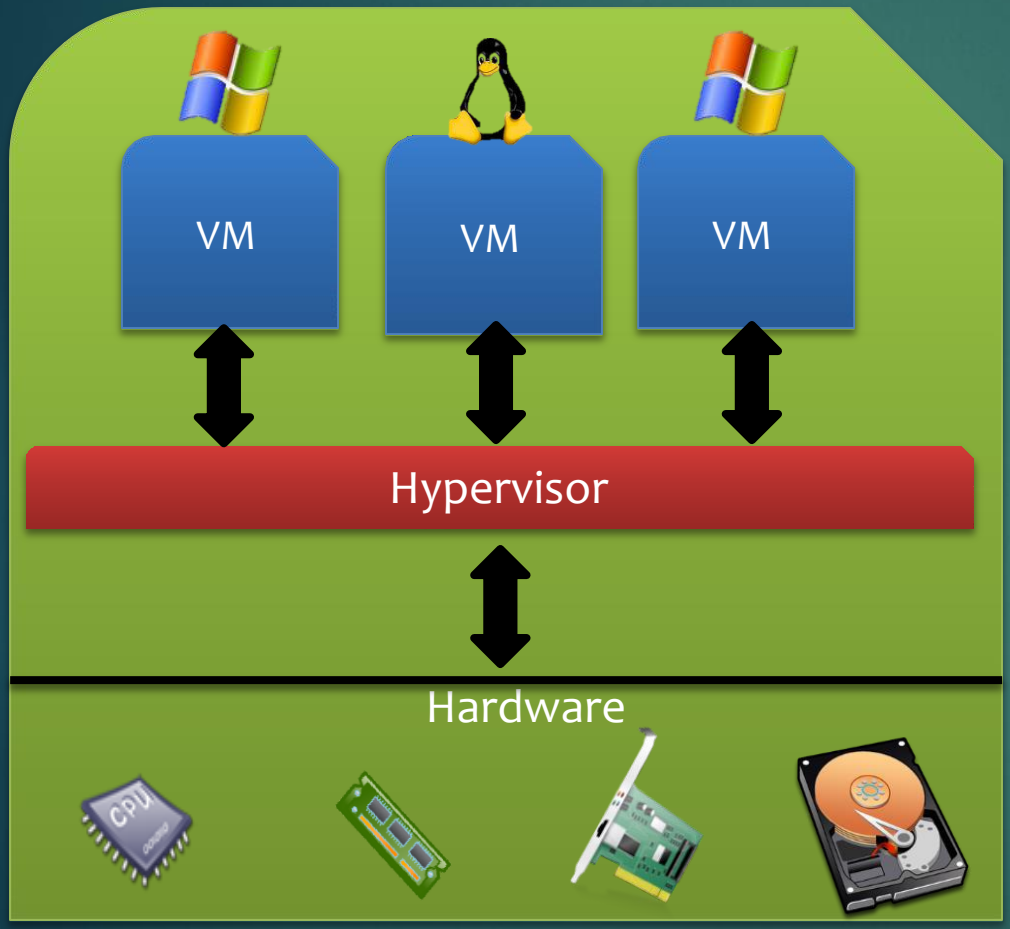
HYPERVISOR IMPLEMENTATION APPROACHES



Hosted Approach

- Type II Hypervisor.
- Runs virtual machines on top of a host OS (windows, Unix etc.)
- Relies on host OS for physical resource management.
- Host operating system provides drivers for communicating with the server hardware.
- E.g.: VirtualBox

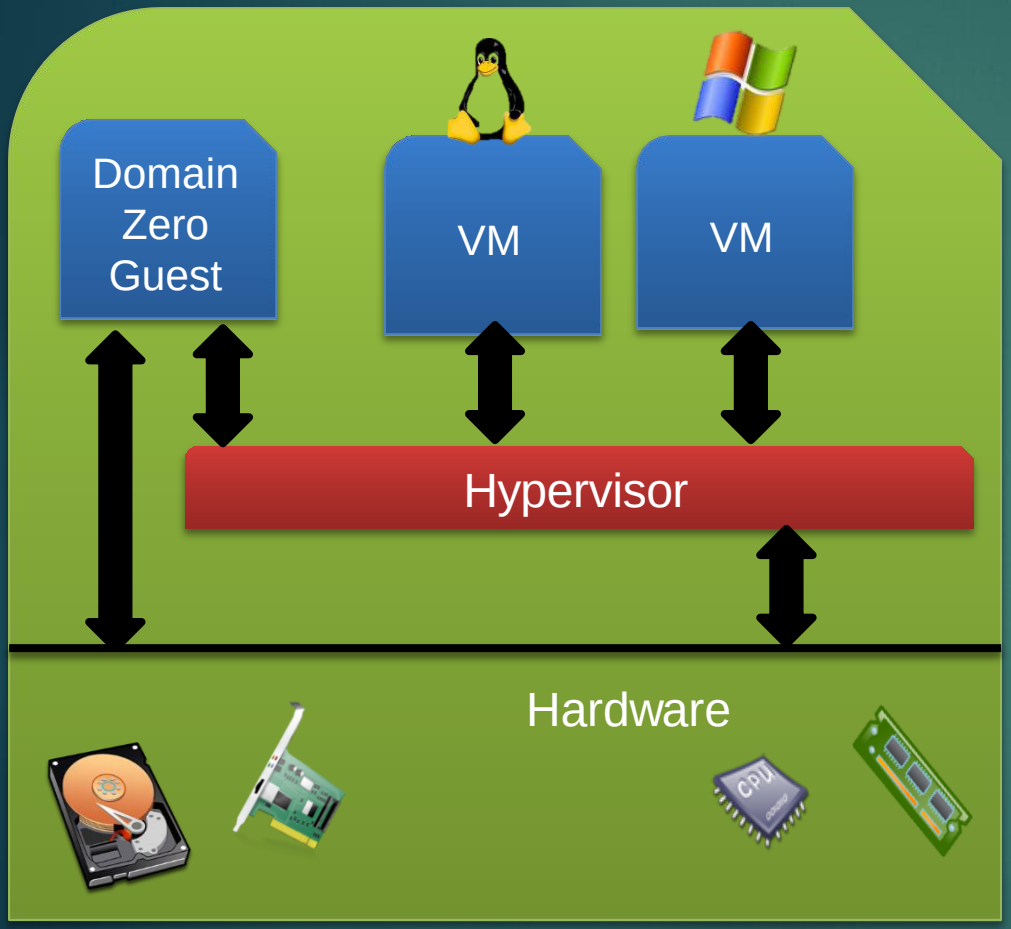
VMWARE ESXI



Architecture of VMWare ESXi

- Bare Metal Approach.
- Full virtualization.
- Proven technology.
- Used for secure and robust virtualization solutions for virtual data centers and cloud infrastructures.
- Takes advantage of support for hardware assisted virtualization for 64-bit OS on Intel processors.

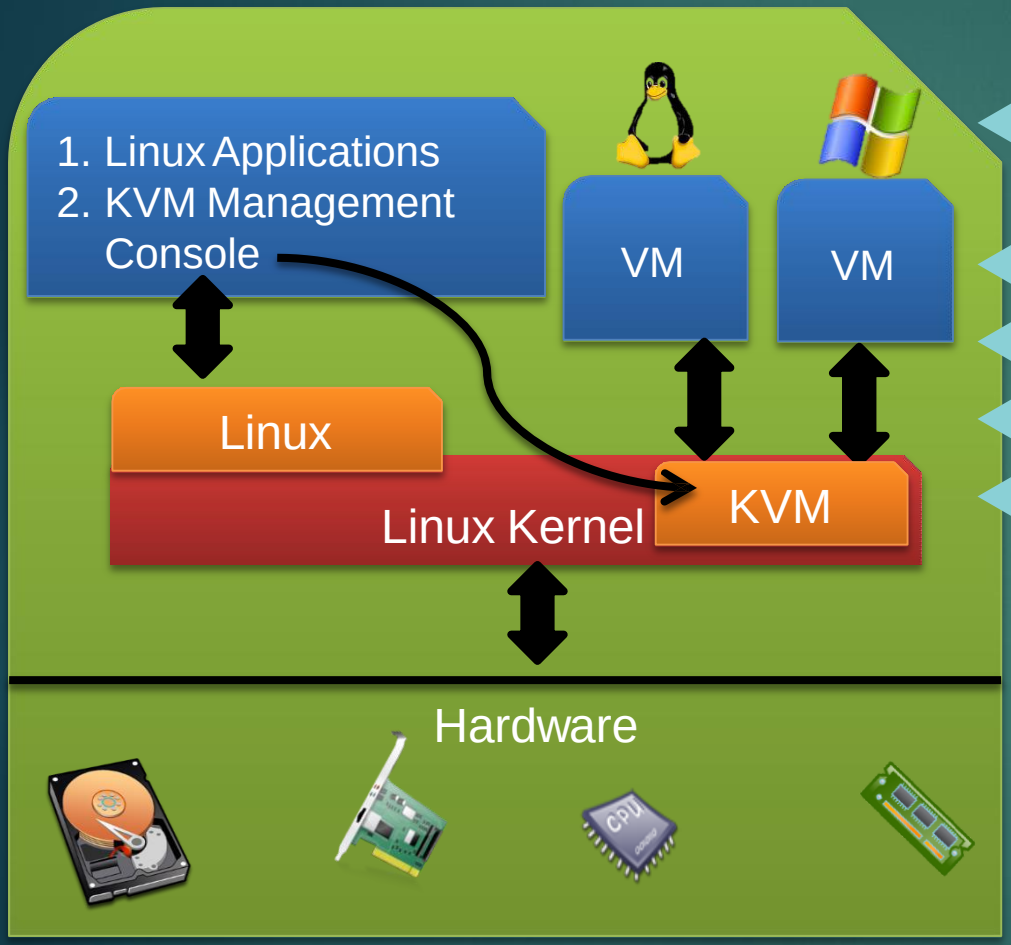
CITRIX XEN SERVER



Architecture of Xen

- Open source; bare metal.
- Offers both Hardware Assisted Virtualization (HVM) and Para-Virtualization (PV)
- Needs virtualization support in the CPU for HVM.
- Xen loads an initial OS which runs as a privileged guest called “domain 0”.
- The domain 0 OS, typically a Linux or UNIX variant, can talk directly to the system hardware (whereas the other guests cannot) and also talk directly to the hypervisor itself. It allocates and maps hardware resources for other guest domains.

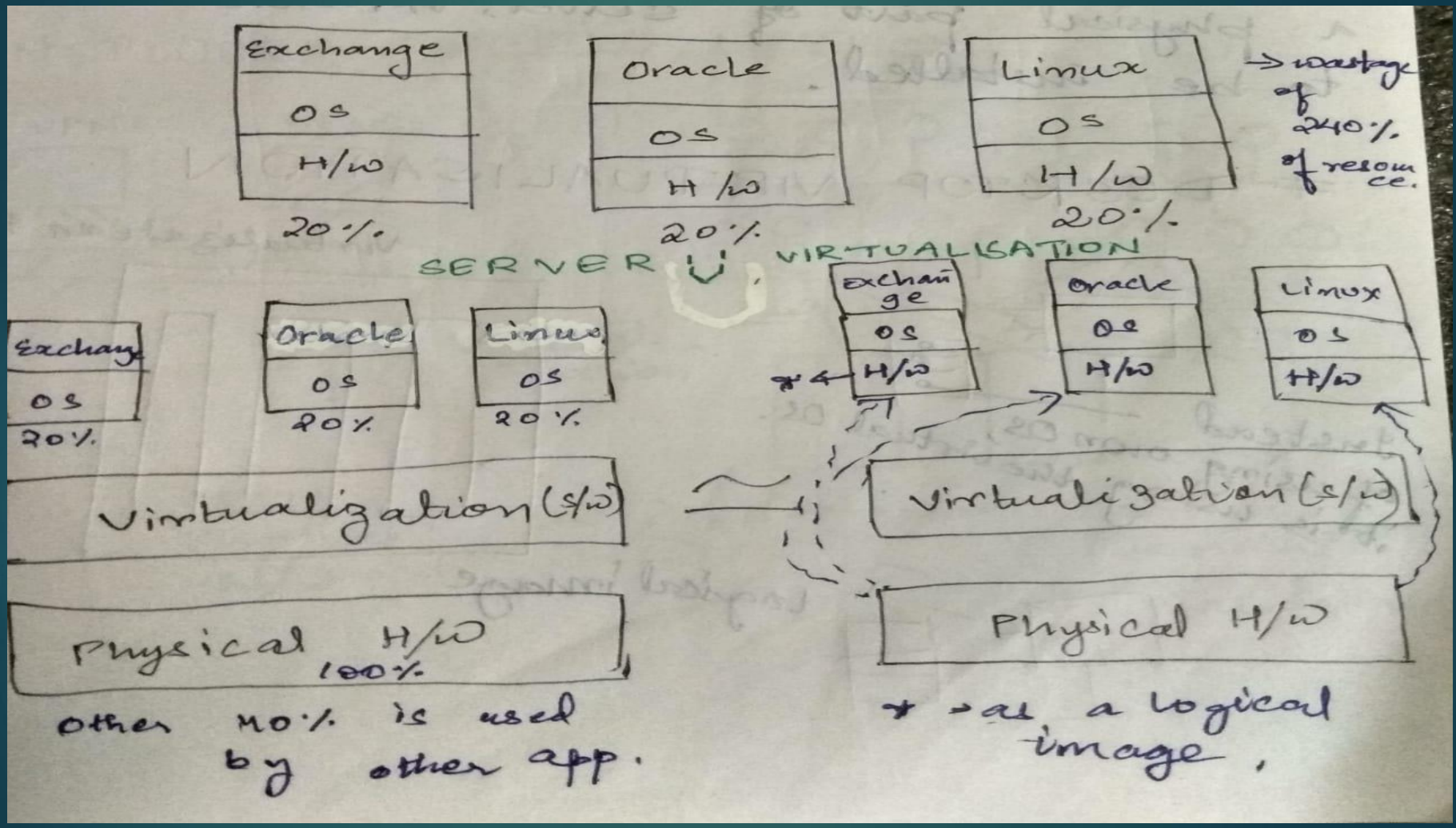
UBUNTU KVM



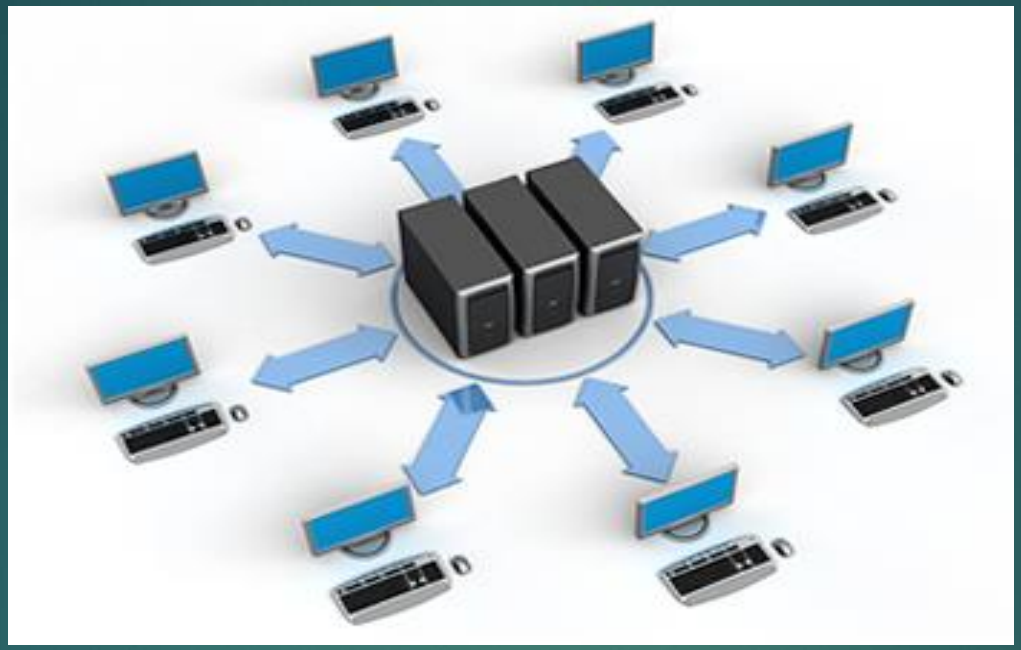
Architecture of KVM

- Kernel based virtual machine (Kernel Based VM)
- Open source.
- Kernel-level extension to Linux.
- Full virtualization.
- Supports full virtualization and hence does not need hardware assisted virtualization support in the CPU.

Virtualization

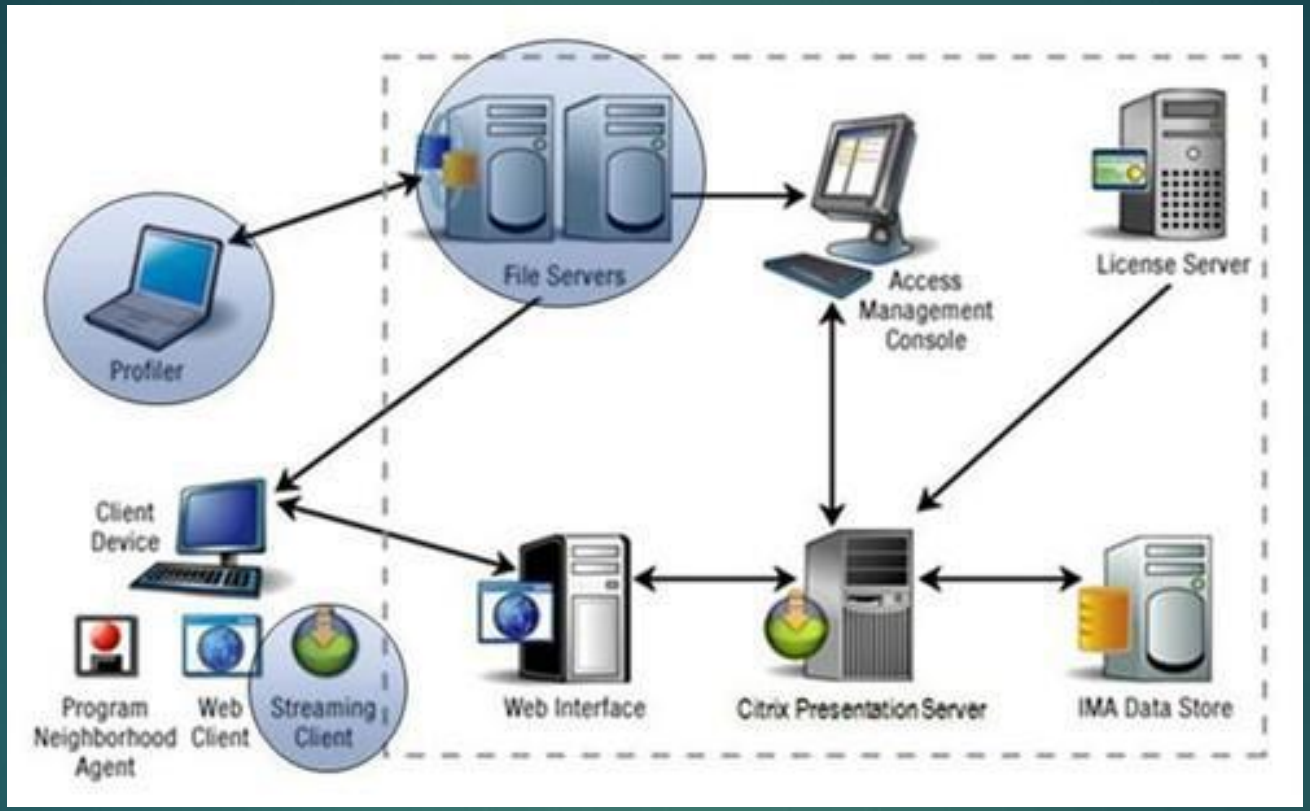


Desktop Virtualization



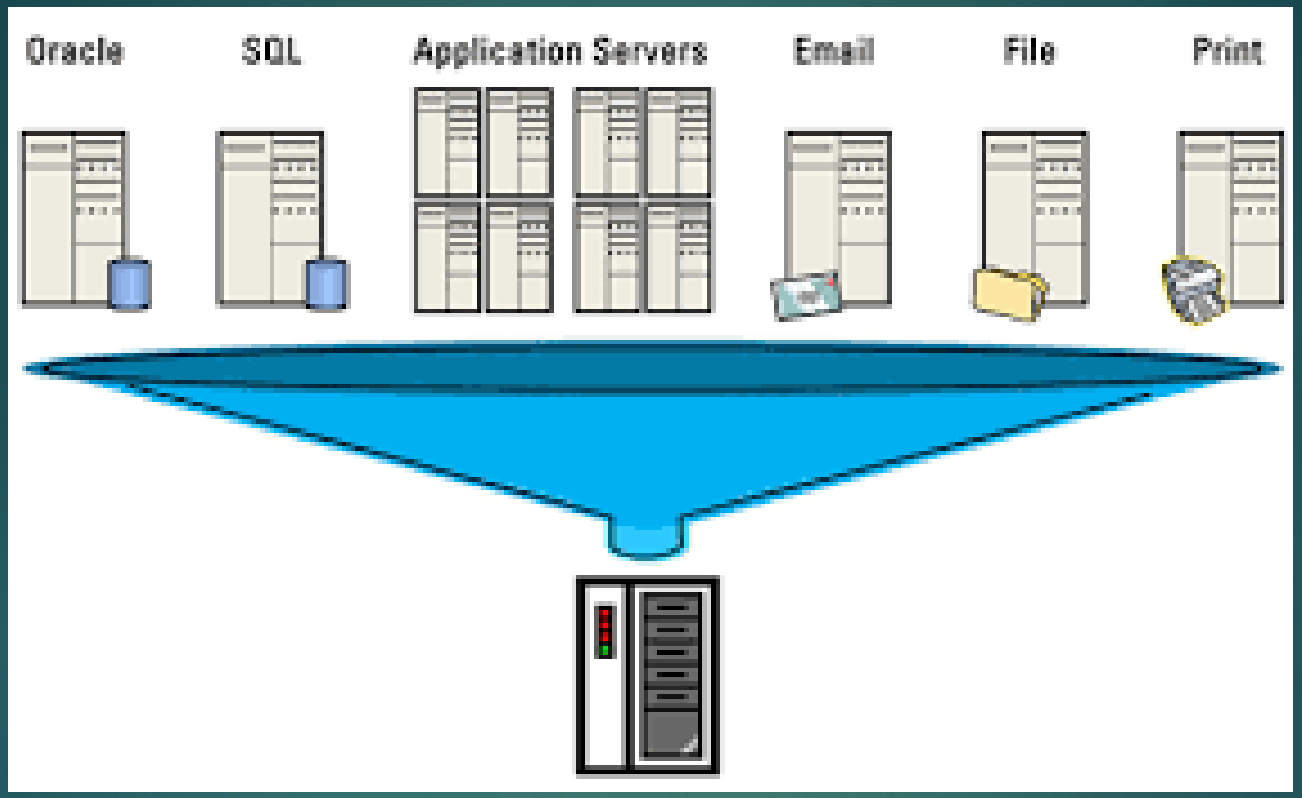
- Desktop Virtualization should be used if application virtualization can't deliver the required applications and desktops.
- Application virtualization using the hosted model (XenApp or RDS) is preferred since you can get more users per server.
- Users that want specific operating systems other than Windows Server will need to have a virtual desktop.

Application Virtualization



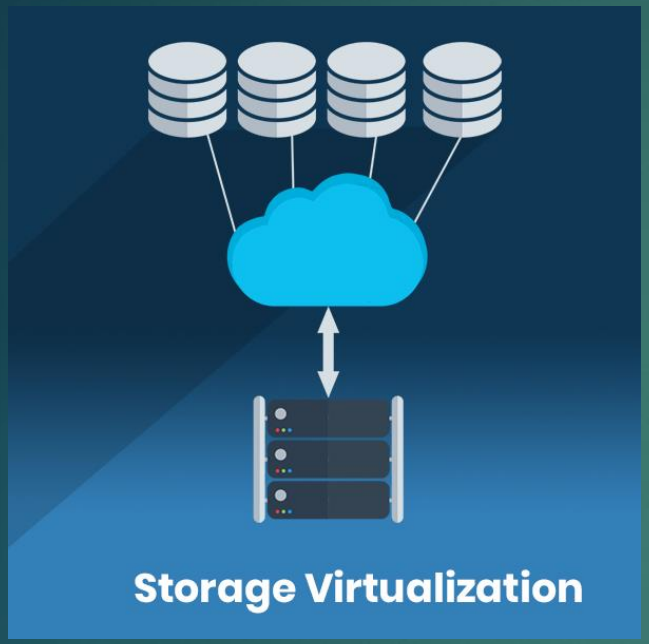
- Application virtualization allows users to run applications from devices that don't possess the operating system the application requires.
- Another possible reason to use application virtualization is to run conflicting programs that can't coexist on the same device.

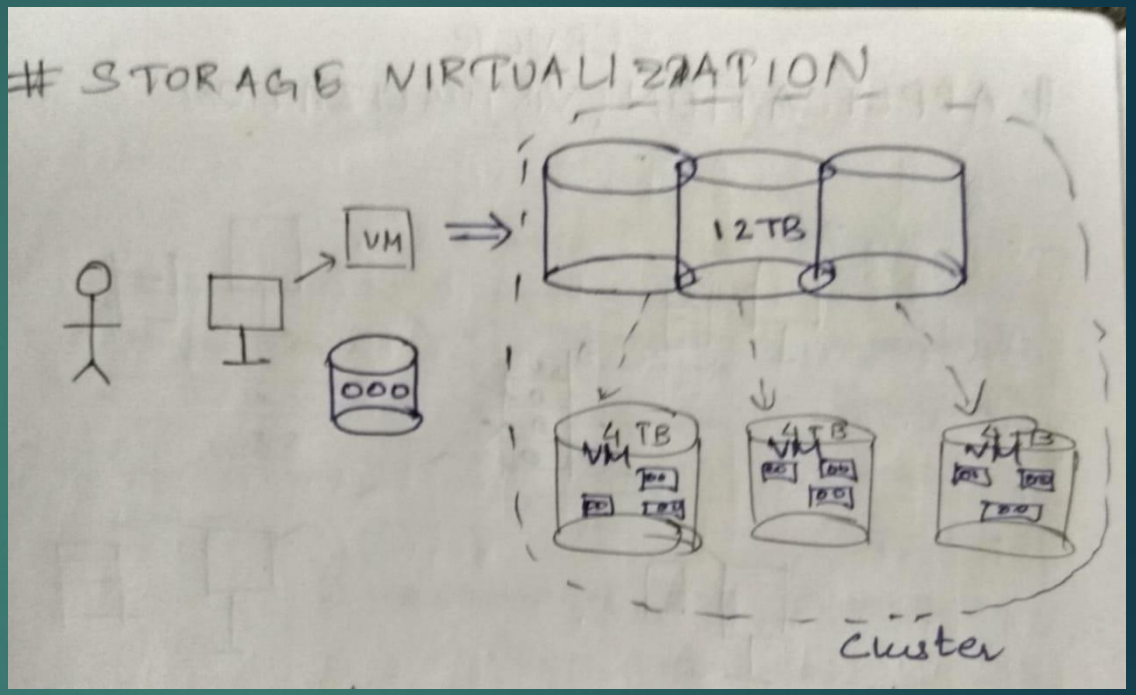
Server Virtualization



Server virtualization separates the operating system from the computer hardware and allows the VM to be treated as a file. This provides for easy management and facilitates redundancy, high availability and disaster recovery.

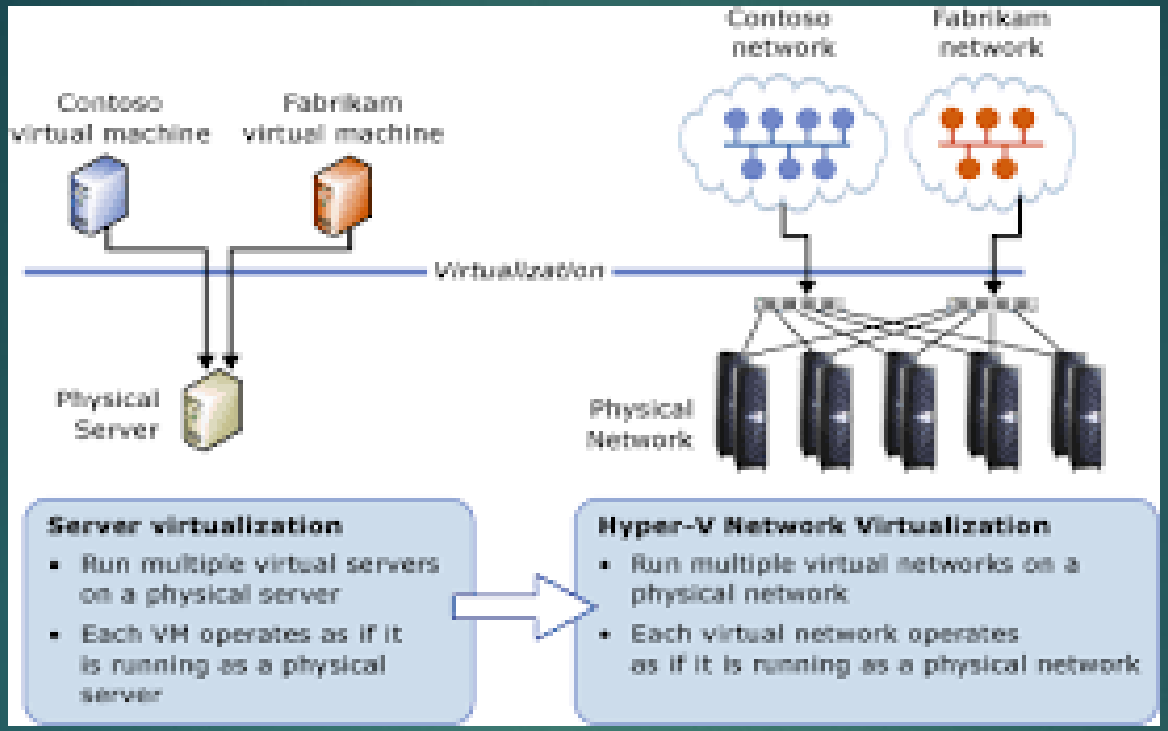
Storage Virtualization





Storage Virtualization goes hand in hand with server virtualization, as when both are used together they provide tremendous flexibility. It makes managing storage from multiple sources to be managed and utilized as a single repository.

Network Virtualization



Network virtualization was developed by using the same concepts of server virtualization. Software Defined Networking uses virtual switches, routers, firewalls and load balancers. This allows IT staff to provision networks without disruption to the physical network while running traffic over the physical network. This allows VM's to retain their security properties when moved from one host server to another that may be located on a different network.