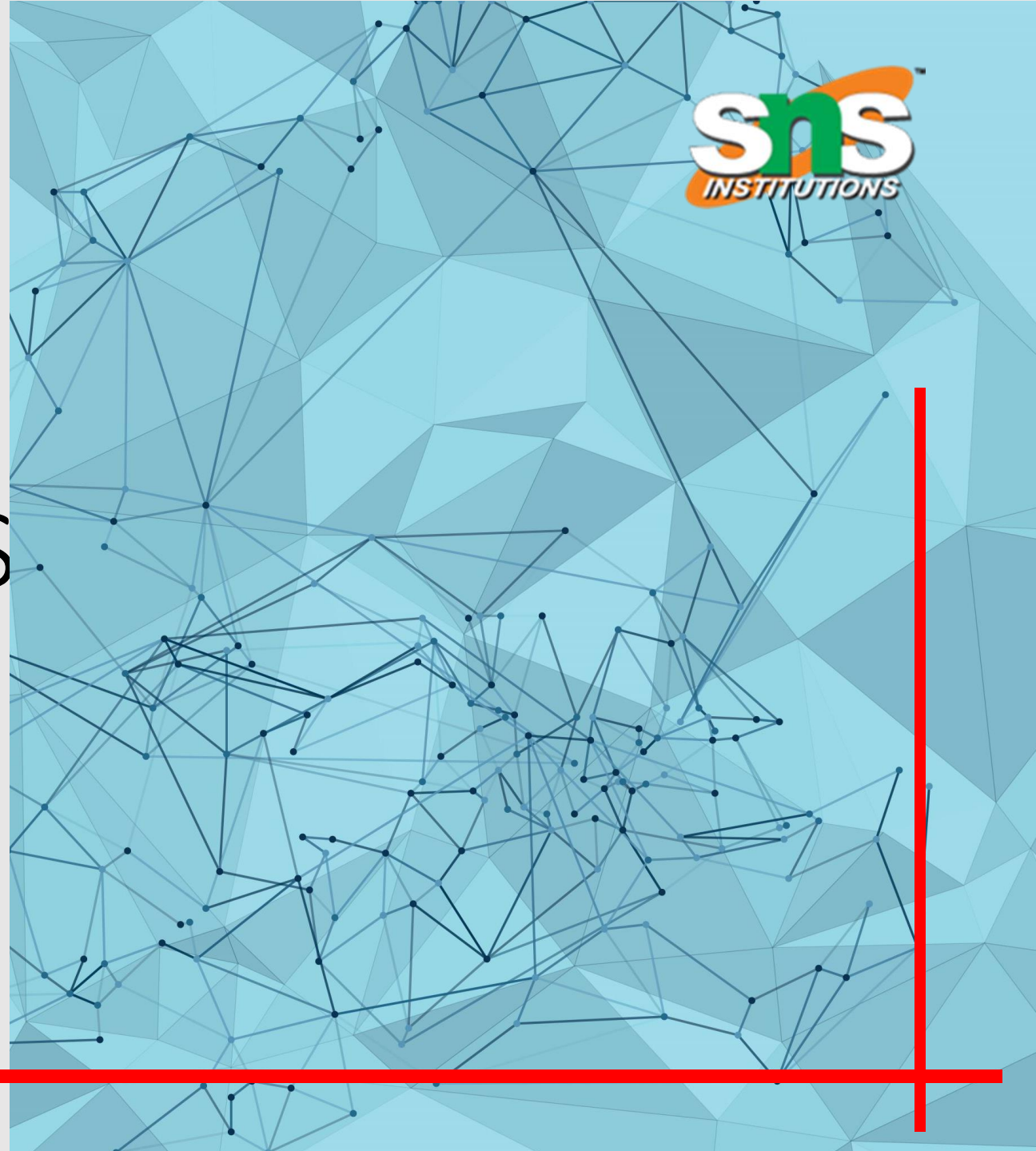
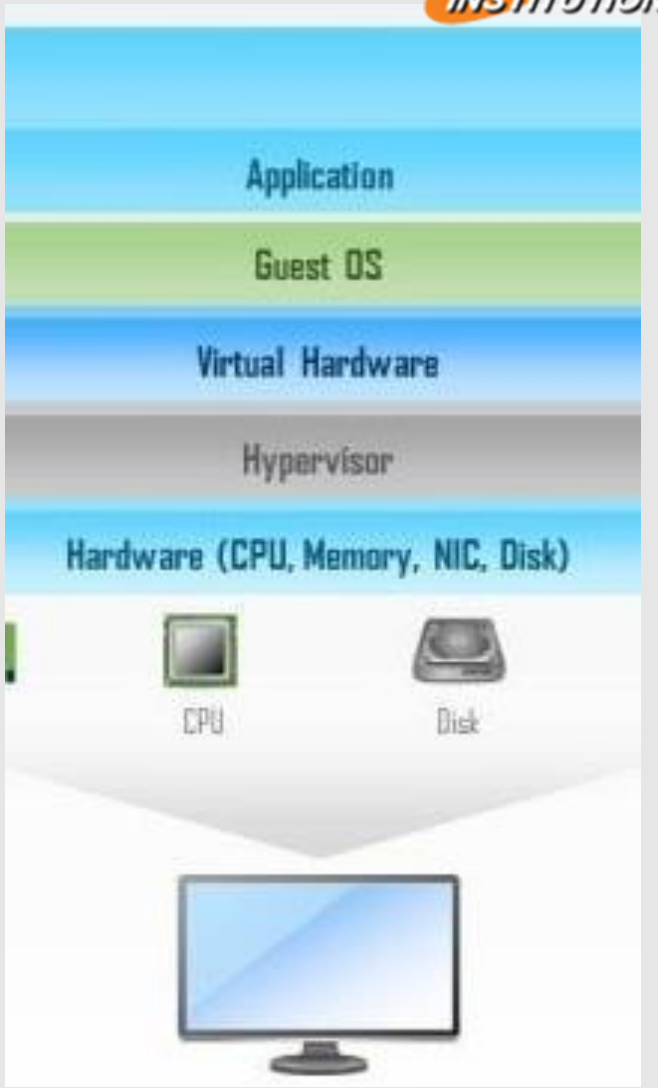
VIRTUALIZATION
&
CLOUD CONCEPTS



WHAT IS VIRTUALIZATION ?

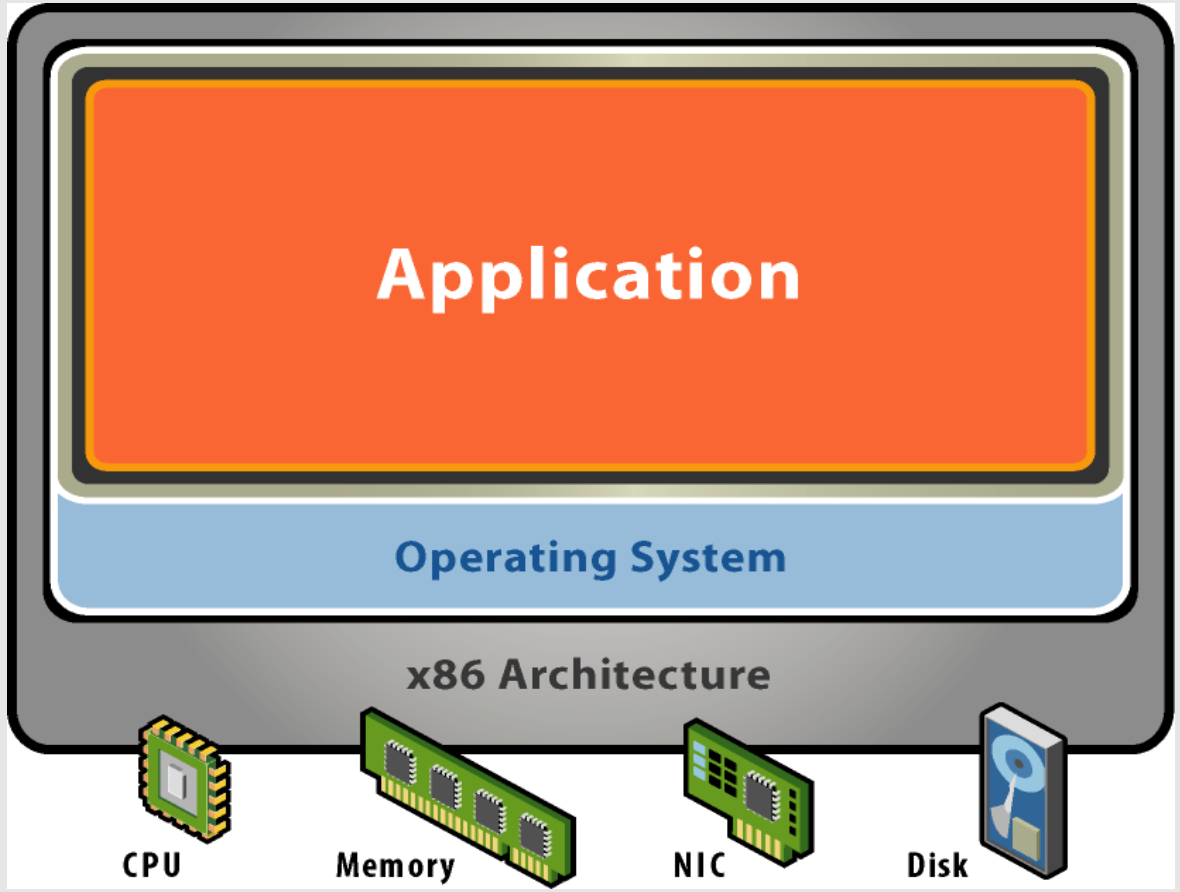
Virtualization is a process that allows for more efficient use of physical computer hardware and is the foundation of cloud computing.

Virtualization uses software to create an abstraction layer over computer hardware, enabling the division of a single computer's hardware components—such as processors, memory and storage—into multiple virtual machines (VMs). Each VM runs its own operating system (OS) and behaves like an independent computer, even though it is running on just a portion of the actual underlying computer hardware.



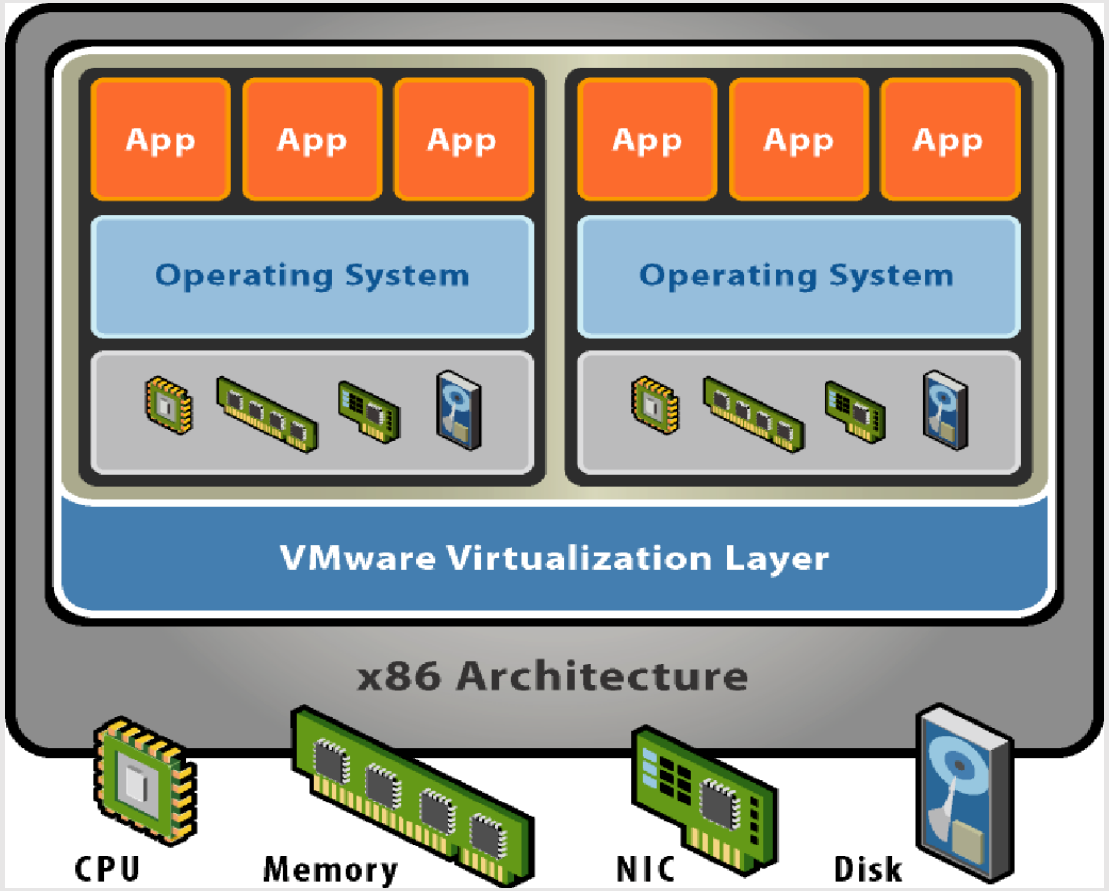
BEFORE VIRTUALIZATION

- Single OS Image per Machine
- Software and Hardware tightly coupled
- Running Multiple applications at same time often creates conflict
- Inflexible and has a costly infrastructure



AFTER VIRTUALIZATION

- Hardware independence of Operating System and Applications
- Virtual Machines can be provisioned to any system
- Can manage OS and application as a single unit by encapsulating them into virtual Machines
- Flexible and Efficient utilization of resources

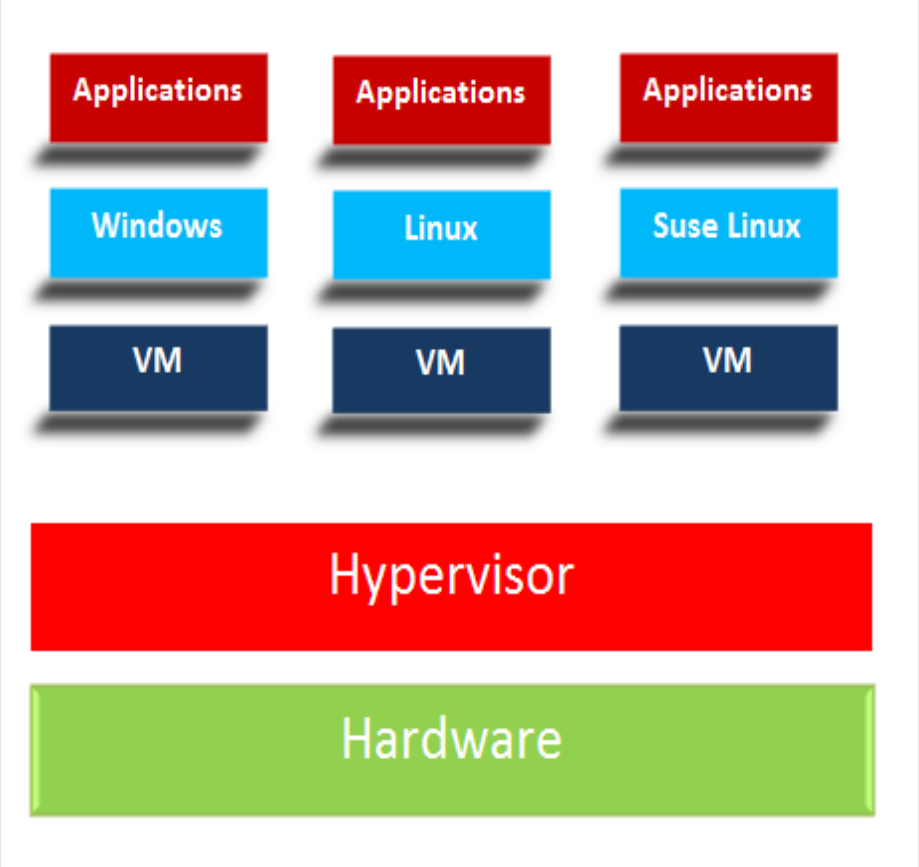


HYPERVISORS

- A hypervisor is the software layer that coordinates VMs.
- It serves as an interface between the VM and the underlying physical hardware, ensuring that each has access to the physical resources it needs to execute.
- It also ensures that the VMs don’t interfere with each other by impinging on each other’s memory space or compute cycles.
- There are two types of hypervisor:
  - Type 1 Hypervisor: Hosted on top of Bare Metal
  - Type 2 Hypervisor: Hosted on top of OS

BARE-METAL ARCHITECTURE

- Hypervisor is established directly on top of the Hardware so it has direct access to hardware resources
- Doesn’t require any base OS
- They most commonly appear in virtual server scenarios.

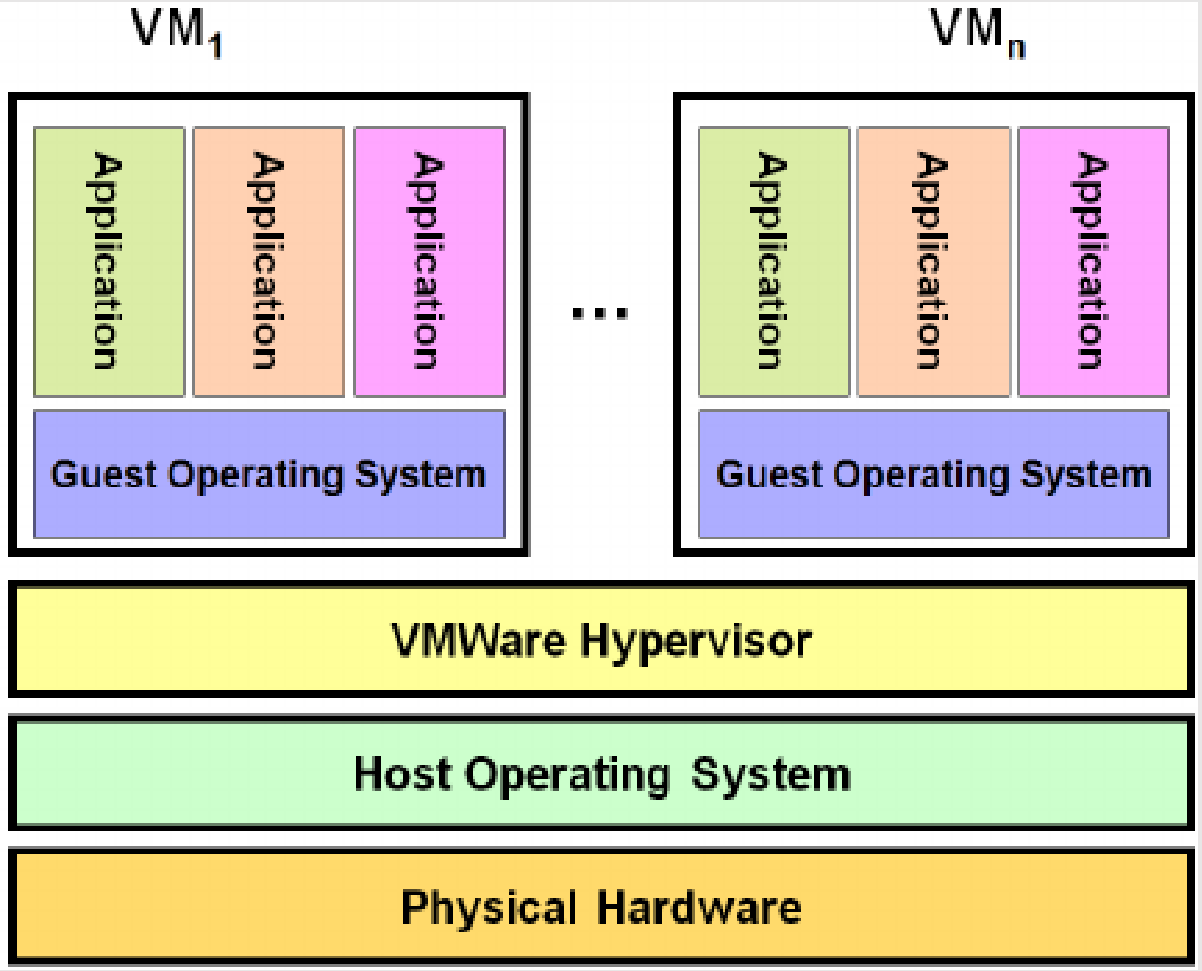


HOSTED ARCHITECTURE

Has a Host Operating System

Hypervisor runs on top of OS

Most commonly used on endpoint devices to run alternative operating systems, they carry a performance overhead because they must use the host OS to access and coordinate the underlying hardware resources..



BENEFITS OF HYPERVISOR

- **Speed**
  - Hypervisors allow virtual machines to be created instantly
- **Efficiency**
  - Hypervisors that run several virtual machines on one physical machine's resources also allow for more efficient utilization of one physical server. It is more cost- and energy-efficient to run several virtual machines on one physical machine than to run multiple underutilized physical machines for the same task

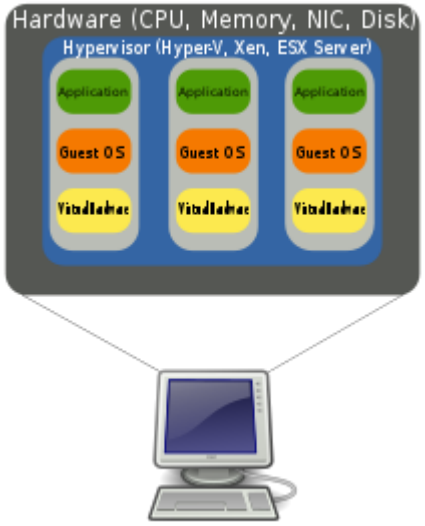
- **Flexibility**
  - Bare-metal hypervisors allow operating systems and their associated applications to run on a variety of hardware types because the hypervisor separates the OS from the underlying hardware, so the software no longer relies on specific hardware devices or drivers.
- **Portability**
  - Since virtual machines are independent from the physical machine, they are portable.

TYPES OF VIRTUALIZATION

- Hardware Virtualization
- Software Virtualization
- Memory Virtualization
- Storage Virtualization
- Network Virtualization
- Data Virtualization
- Desktop Virtualization

HARDWARE VIRTUALIZATION

- Also known as server virtualization
- When the virtual machine software or virtual machine manager (VMM) is directly installed on the hardware system is known as hardware virtualization.
- The hardware resource allotment is done by the hypervisor.
- The main advantages include increased processing power as a result of maximized hardware utilization.



SOFTWARE VIRTUALIZATION

- Software Virtualization involves the creation of an operation of multiple virtual environments on the host machine.
- It creates a computer system complete with hardware that lets the guest operating system to run.
- For example, it lets you run Android OS on a host machine natively using a Microsoft Windows OS, utilizing the same hardware as the host machine does.

MEMORY VIRTUALIZATION

- Physical memory across different servers is aggregated into a single virtualized memory pool. It provides the benefit of an enlarged contiguous working memory.
- You may already be familiar with this, as some operating systems such as Microsoft Windows allows a portion of your storage disk to serve as an extension of your RAM.

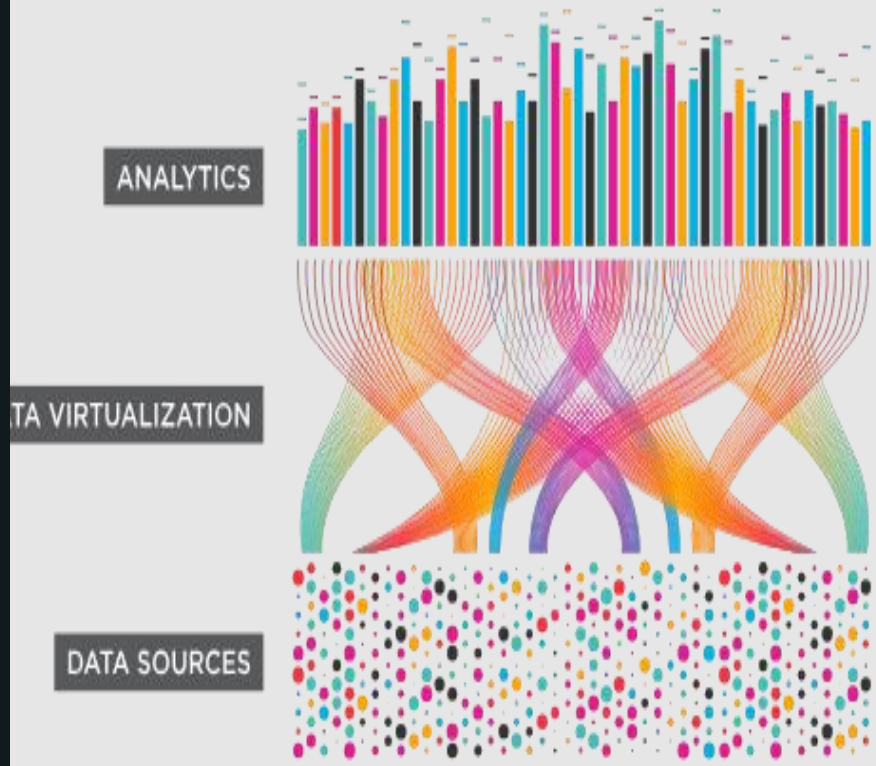
STORAGE VIRTUALIZATION

- Multiple physical storage devices are grouped together, which then appear as a single storage device.
- This provides various advantages such as homogenization of storage across storage devices of multiple capacity and speeds.
- Partitioning your hard drive into multiple partitions is an example of virtualization.

NETWORK VIRTUALIZATION

- In network virtualization, multiple sub-networks can be created on the same physical network, which may or may not is authorized to communicate with each other.
- This enables restriction of file movement across networks and enhances security, and allows better monitoring and identification of data usage which lets the network administrator’s scale up the network appropriately.
- It also increases reliability as a disruption in one network doesn’t affect other networks, and the diagnosis is easier.
- Eg: vLAN(Virtual Local Area Network)

DATA VIRTUALIZATION



- It lets you easily manipulate data, as the data is presented as an abstract layer completely independent of data structure and database systems. Decreases data input and formatting errors.
- Data virtualization tools create a software layer between the applications accessing the data and the systems storing it.
- The layer translates an application’s data request or query as needed and returns results that can span multiple systems.

DESKTOP VIRTUALIZATION

- This is perhaps the most common form of virtualization for any regular IT employee.
- The user’s desktop is stored on a remote server, allowing the user to access his desktop from any device or location.
- Employees can work conveniently from the comfort of their home. Since the data transfer takes place over secure protocols, any risk of data theft is minimized

BENEFITS OF VIRTUALIZATION

- **Increase efficiency and productivity**
  - With fewer servers, your IT teams will be able to spend less time maintaining the physical hardware. You'll be able to install, update, and maintain the environment across all the virtual machines on the server instead of going through the laborious and tedious process of applying the updates server-by-server.
- **Smoother IT Operations**
  - Virtual networks help IT professionals become efficient and agile at work. These networks are easy to operate and process faster, reducing the effort and time required to work on them. Before virtual networks were introduced in the digital world, it would take days and weeks for technical workers to maintain and install devices and software on physical servers.

Hassle-free Transfer of Data

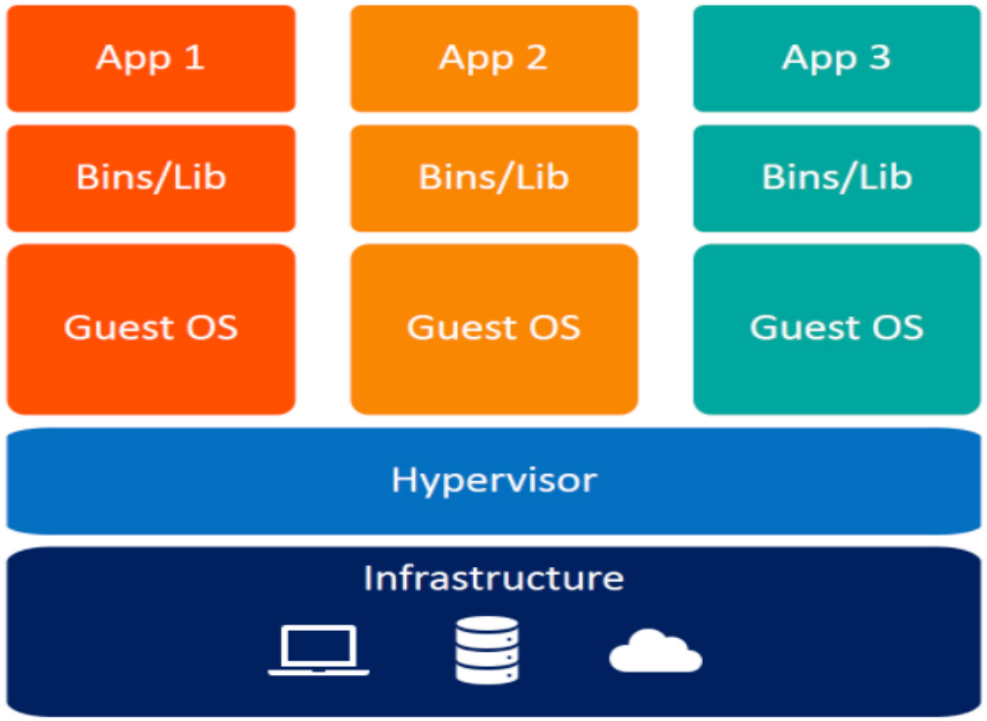
- You can easily transfer data from a physical storage to a virtual server, and vice versa. Administrators don’t have to waste time digging out hard drives to find data With a Chahal dedicated server and storage, it’s quite easy to locate the required files and transfer them within no time.

Security

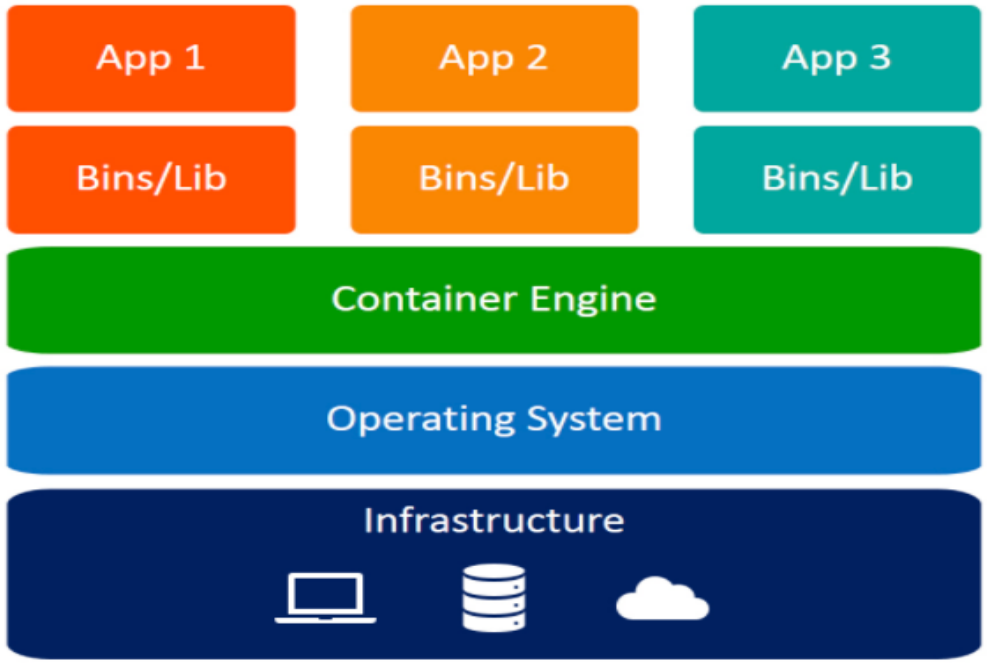
- During the process of virtualization security is one of the important concerns. The security can be provided with the help of firewalls, which will help to prevent unauthorized access and will keep the data confidential.

- **Protection from System Failures**
  - While performing some task there are chances that the system might crash down at the wrong time. This failure can cause damage to the company but the virtualizations help you to perform the same task in multiple devices at the same time.
- **Cost-Effective**
  - saves the cost for a physical system such as hardware and servers. It stores all the data in the virtual server, which are quite economical.

VIRTUALIZATION VS CONTAINERIZATION



Virtual Machines



Containers

VIRTUALIZATION AND CLOUD COMPUTING

- Cloud computing is the on-demand delivery of computing resources over the internet with pay-as-you-go pricing. Instead of buying, owning, and maintaining a physical data center, you can access technology services, such as computing power, storage, and databases, as you need them from a cloud provider.
- Virtualization technology makes cloud computing possible. Cloud providers set up and maintain their own data centers.
- They create different virtual environments that use the underlying hardware resources. You can then program your system to access these cloud resources by using APIs. Your infrastructure needs can be met as a fully managed service.

WHAT IS CLOUD ARCHITECTURE

Cloud architecture is the way technology components combine to build a cloud, in which resources are pooled through virtualization technology and shared across a network. The components of a cloud architecture include:

- A front-end platform (the client or device used to access the cloud)
- A back-end platform (servers and storage)
- A cloud-based delivery model
- A network

Together, these technologies create a cloud computing architecture on which applications can run, providing end-users with the ability to leverage the power of cloud resources.

BENEFITS OF CLOUD ARCHITECTURE

Cloud computing architecture enables organizations to reduce or eliminate their reliance on an on-premises server, storage, and networking infrastructure.

Organizations adopting cloud architecture often shift IT resources to the public cloud, eliminating the need for on-premises servers and storage, reducing the need for IT data center real estate, cooling, and power, and replacing them with a monthly IT expenditure.

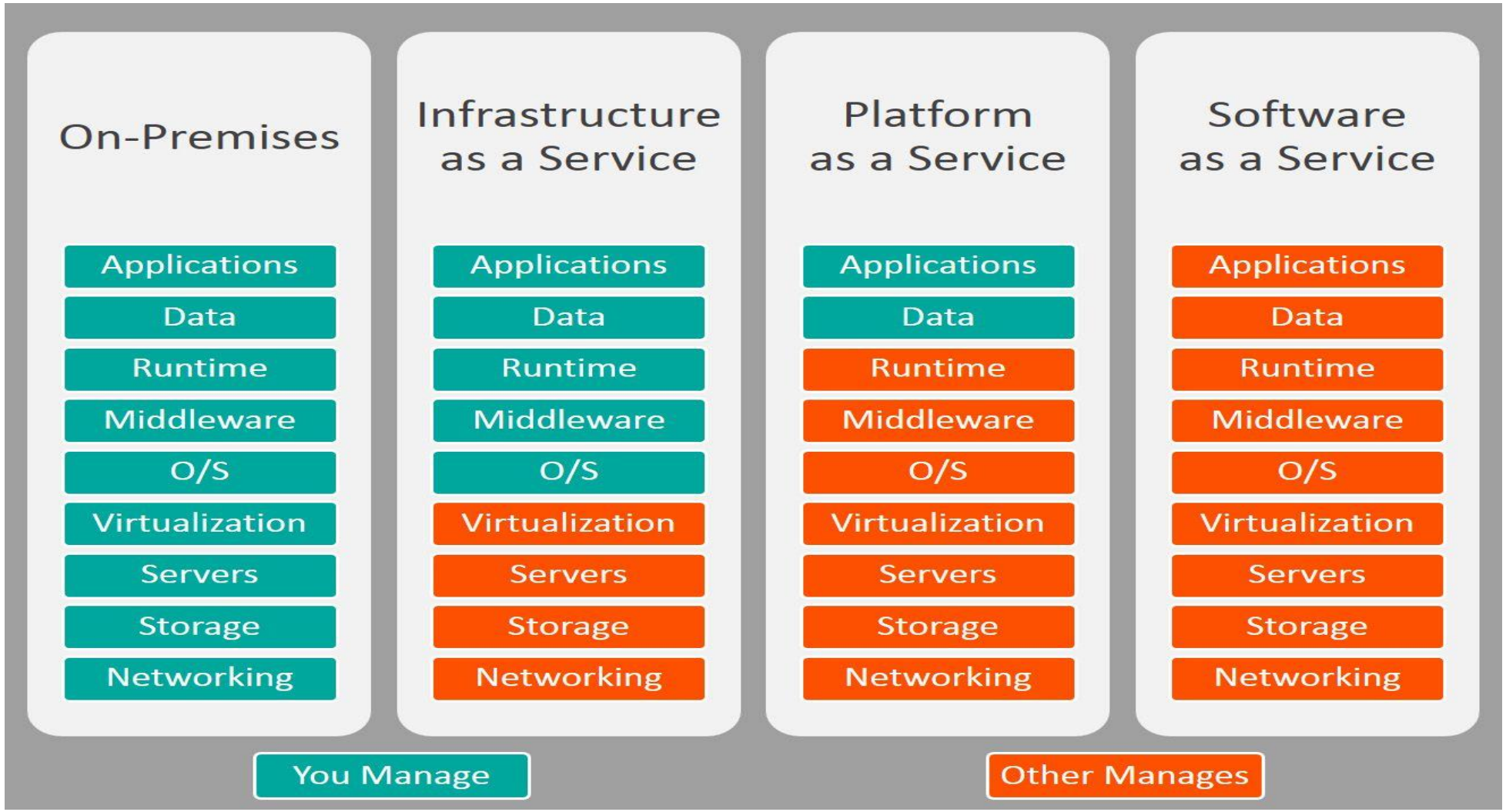
This shift from capital expenditure to operating expense is a major reason for the popularity of cloud computing today.

TYPES OF CLOUD SERVICES

- There are three major models of cloud architecture that are driving organizations to the cloud. Each of these has its own benefits and key features. They are SaaS, PaaS, IaaS

- **Software as a Service (SaaS)**
  - SaaS architecture providers deliver and maintain applications and software to organizations over the Internet, thereby eliminating the need for end users to deploy the software locally. SaaS applications are typically accessed via a web interface available from a broad variety of devices and OSes.

- **Platform as a Service (PaaS):**
  - In this cloud model, the service provider offers a computing platform and solution stack, often including middleware, as a service. Organizations can build upon that platform to create an application or service. The cloud service provider delivers the networks, servers, and storage required to host an application while the end user oversees software deployment and configuration settings.
- **Infrastructure as a Service (IaaS):**
  - In this, cloud at its simplest form, a third-party provider eliminates the need for organizations to purchase servers, networks, or storage devices by providing the necessary infrastructure. In turn, organizations manage their software and applications and only pay for the capacity they need at any given time.


On-Premises
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
Infrastructure as a Service
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
Platform as a Service
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
Software as a Service
Applications
Data
Runtime
Middleware
O/S
Virtualization
Servers
Storage
Networking
You Manage
Other Manages

CLOUD ARCHITECTURE MODELS

- Although no two clouds are alike, there are a number of common cloud architecture models.
- These include public, private, hybrid, and multi-cloud architectures. Here is how they compare:
- **Public cloud architecture:**
  - In a public cloud architecture, computing resources are owned and operated by a cloud services provider.
  - These resources are shared and redistributed across multiple tenants via the Internet. Advantages of the public cloud include reduced operating costs, easy scalability, and little to no maintenance.

- **Private cloud architecture:**
  - Private cloud refers to a cloud that is owned and managed privately, usually in a company's own on-premises data center.
  - However, the private cloud can also span to include multiple server locations or leased space in geographically scattered colocation facilities.
  - Although typically more expensive than public cloud solutions, private cloud architecture is more customizable and can offer stringent data security and compliance options.
- **Hybrid cloud architecture:**
  - A hybrid cloud environment combines the operating efficiencies of the public cloud and the data security capabilities of the private cloud.
  - By utilizing both public and private cloud architectures, hybrid clouds help consolidate IT resources while enabling organizations to migrate workloads between environments depending on their IT and data security requirements.

- **Multi-cloud architecture:**
  - A multi-cloud architecture is one that uses multiple public cloud services.
  - The advantages of a multi-cloud environment include greater flexibility to choose and deploy the cloud services that are most likely to satisfy varying organizational requirements.
  - Another upside is reduced reliance on any single cloud services vendor for greater cost savings and a lower likelihood of vendor lock-in.
  - Additionally, multi-cloud architecture may be required to support microservices-based containerized applications, where services exist on multiple clouds.

IoT CLOUD PLATFORM

- IoT cloud platforms bring together capabilities of IoT devices and cloud computing delivered as a end-to-end service
- There are several IoT Cloud Platforms in the market today provided by different service providers that host wide ranging applications.
- These can also be extended to services that use advanced machine learning algorithms for predictive analysis, especially in disaster prevention and recovering planning using data from the edge devices.
- An IoT cloud platform may be built on top of generic clouds such as those from Microsoft, Amazon, Google or IBM.

- In general, there are two kinds of IoT software architectures:
- **Cloud-centric:** Data from IoT devices such as sensors are streamed to a data centre where all the applications that do the analytics and decision making are executed, using real-time and past data from one or more sources. Servers in the cloud control the edge devices too.
- **Device-centric:** All the data is processed in the device (sensor nodes, mobile devices, edge gateways), with only some minimal interactions with the cloud for firmware updates or provisioning. Terms such Edge Computing and Fog Computing are used in this case.

THANK YOU