NOTES ON CLOUD COMPUTING

History of Cloud Computing

Before emerging the cloud computing, there was Client/Server computing which is basically a centralized storage in which all the software applications, all the data and all the controls are resided on the server side. If a single user wants to access specific data or run a program, he/she need to connect to the server and then gain appropriate access, and then he/she can do his/her business. Then after, distributed computing came into picture, where all the computers are networked together and share their resources when needed. On the basis of above computing, there was emerged of cloud computing concepts that later implemented.

At around in 1961, John McCarthy suggested in a speech at MIT that computing can be sold like a utility, just like a water or electricity. It was a brilliant idea, but like all brilliant ideas, it was ahead if its time, as for the next few decades, despite interest in the model, the technology simply was not ready for it. But of course time has passed and the technology caught that idea and after few years we mentioned that:

In 1999, **Salesforce.com** started delivering of applications to users using a simple website. The applications were delivered to enterprises over the Internet, and this way the dream of computing sold as utility were true.

In 2002, **Amazon** started Amazon Web Services, providing services like storage, computation and even human intelligence. However, only starting with the launch of the Elastic Compute Cloud in 2006 a truly commercial service open to everybody existed.

In 2009, **Google Apps** also started to provide cloud computing enterprise applications.

Of course, all the big players are present in the cloud computing evolution, some were earlier, some were later. In 2009, **Microsoft** launched Windows Azure, and companies like Oracle and HP have all joined the game. This proves that today, cloud computing has become mainstream.

Cloud Computing Definition—

A style of computing where massively scalable (and elastic) IT-related capabilities are provided "as a service" to external customers using Internet technologies.
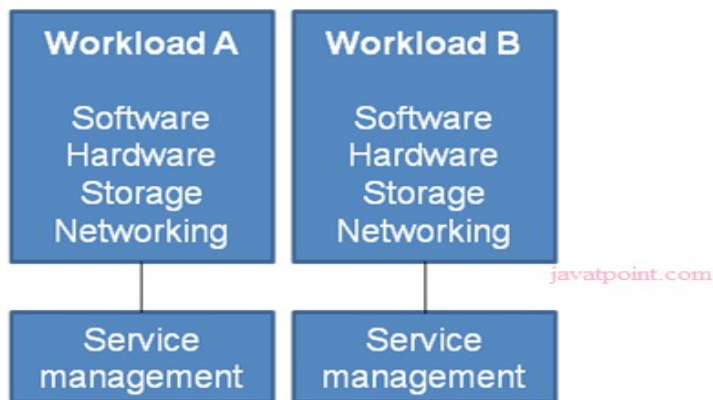
What is Cloud Computing?

Cloud computing means on demand delivery of IT resources via the internet with pay-as-you-go pricing. It provides a solution of IT infrastructure in low cost.
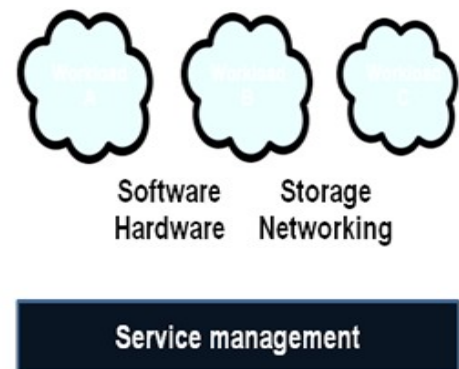
Why Cloud Computing?

Actually, Small as well as some large IT companies follows the traditional methods to provide the IT infrastructure. That means **for any IT company, we need a Server Room that is the basic need of IT companies.**In that server room, there should be a database server, mail server, networking, firewalls,routers, modem, switches, QPS (Query Per Second means how much queries or load will be handled by the server) , configurable system, high net speed and the maintenance engineers.To establish such IT infrastructure, we need to spend lots of money. To overcome all these problems and to reduce the IT infrastructure cost, Cloud Computing comes into existence.

Characteristics of Cloud Computing

1) Agility
The cloud **works in the distributed computing environment**. It shares resources among users and works very fast.

2) High availability and reliability
Availability of servers is high and more reliable, because **chances of infrastructure failure are minimal**.

3) High Scalability
Means **"on-demand" provisioning of resources on a large scale**, without having engineers for peak loads.

4) Multi-Sharing
With the help of cloud computing, **multiple users and applications can work more efficiently** with cost reductions by sharing common infrastructure.

5) Device and Location Independence
Cloud computing enables the users to access systems using a web browser regardless of their location or what device they use e.g. PC, mobile phone etc. **As infrastructure is off-site**(typically provided by a third-party) **and accessed via the Internet, users can connect from anywhere**.

6) Maintenance
Maintenance of cloud computing applications is easier, since they **do not need to be installed on each user's computer and can be accessed from different places**. So, it reduces the cost also.

7) Low Cost
By using cloud computing, the cost will be reduced because to take the services of cloud computing, **IT company need not to set its own infrastructure** and pay-as-per usage of resources.

Advantages of Cloud Computing

There are various advantages of cloud computing technology. The important advantages of cloud computing are given below.

1) Lower cost computer for users

In cloud, you don't require a high-powered (and accordingly high-priced) computer to run cloud computing's web based applications because applications run on cloud not on desktop PC or laptop.

2) Lower IT infrastructure cost

By using cloud computing, you need not to invest in larger numbers of more powerful servers, you also need not to require the IT staff for handling such powerful servers.

3) Fewer maintenance cost

The maintenance cost in cloud computing greatly reduces both hardware and software maintenance for organizations of all sizes.

4) Lower Software Cost

It reduces the software cost because you don't need to purchase separate software packages for each computer in the organization.

5) Instant software updates

Another software-related advantage in cloud computing is that users don't need to face with the choice between obsolete software and high upgrade costs. If the app is web-based, updates happen automatically and are available next time when the user logs in to the cloud.

6) Increased computing Power

The execution capacity of cloud servers are very high. It processes the application very fast.

7) Unlimited storage capacity

Cloud offers you a huge amount of storage capacity like 2000 GB or more than that if required.

8) Services in pay-per-use mode
Application Programming Interfaces **(APIs) are provided to the users so that they can access services on the cloud** by using these APIs **and pay the charges as per the usage of services**.

<u>Disadvantages of Cloud Computing</u>

There are various disadvantages of cloud computing technology. The important disadvantages of cloud computing are given below.

1) Require a constant Internet Connection

Cloud computing is impossible without Internet connection. To access any applications and documents you need a constant Internet connection.

2) Require High Speed Internet connection

Similarly, a low-speed Internet connection makes cloud computing painful at best and often impossible. Web based apps often require a lot of bandwidth to download, as need to download large documents.

3) Stored Data Might Not Be Secure

With cloud computing, all your data is stored in the cloud. That's all well and good, but how secure is the cloud? Can't unauthorized users gain access to your confidential data?

TYPES OF CLOUDS

Public Cloud

Public cloud allows the accessibility of systems and services easily to general public. Eg: Amazon, IBM, Microsoft, Google, Rackspace etc.

Fig - Public Cloud
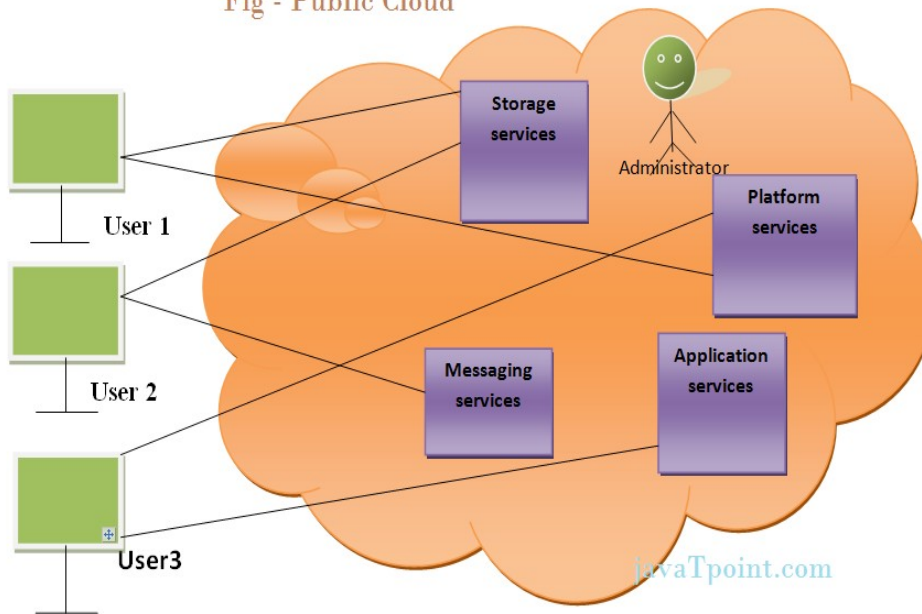
Advantages of Public Cloud Model

1) Low Cost

Public cloud is having low cost as compared to private or hybrid cloud, because it shares same resources with large number of consumer.

2) Reliable

Public cloud provides large number of resources from different locations, if any of the resource fail, public cloud can employ another one.

3) Flexible

It is very easy to integrate public cloud with private cloud and hence it gives flexible approach to consumers.

4) Location Independent

It ensures the independency of location, because public cloud services are delivered through Internet.

5) High Scalability

Cloud resources are available as per the demand from the pool of resources that means they can be scaled up or down according to the requirement.

Disadvantages of Public Cloud Model

1) Low security

In public cloud model, data is present off-site and resources are shared publicly. Hence it does not ensure the high level security.
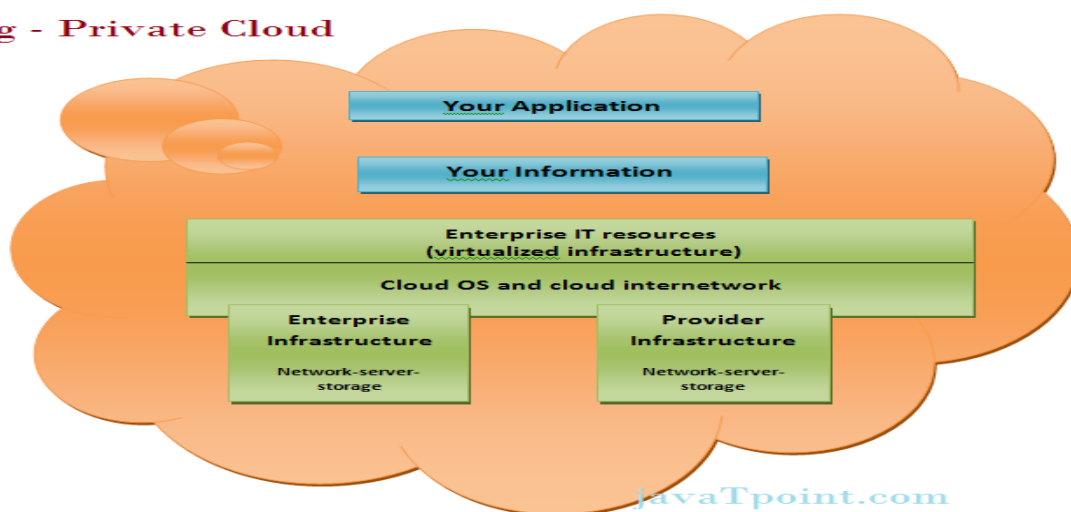
2) Less customizable

It is less customizable than private cloud.

Private Cloud

The Private cloud allows the accessibility of systems and services within the organization. Private cloud is operated only within a particular organization. But it will be managed internally or by third party.

Fig - Private Cloud

Advantages of Private Cloud Model

1) High security and privacy

Private cloud resources are shared from distinct pool of resources and hence highly secured.

2) More Control

Private clouds have more control on its resources and hardware than public cloud because it is accessed only within the boundary of an organization.

Disadvantages of Private Cloud Model

1) Restriction

Private cloud is only accessible locally and it is very difficult to deploy globally.

2) More Cost

cloud is having more cost than public clouds.

3) Inflexible price

In order to fulfill demands, purchasing new hardware is very costly.

4) Less Scalability

Private clouds are scaled only within capacity of internal hosted resources.

Hybrid Cloud

The Hybrid cloud is the mixture of public and private cloud. Non-critical activities are performed by public cloud while critical activities are performed by private cloud.

Fig - Hybrid Cloud
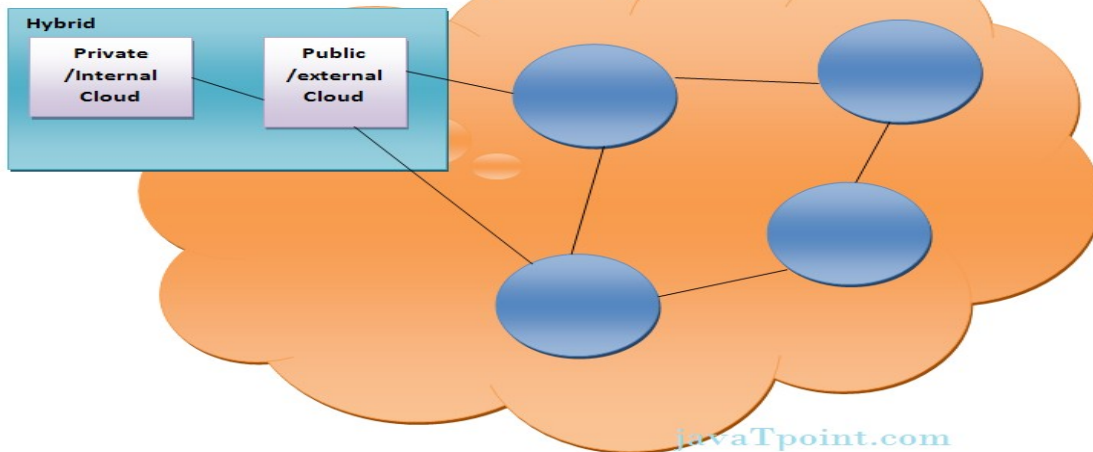
Advantages of Hybrid Cloud Model

1) Scalable

It provides both the features of public and private cloud scalability.

2) Flexible and secure

It provides secure resources because of private cloud and scalable resources because of public cloud.

3) Cost effective

It is having less cost as compared to private cloud.

Disadvantages of Hybrid Cloud Model

1) Networking issues

Networking becomes complex because of private and public cloud.

2) Security Compliance

It is necessary to ensure that cloud services are compliant with the security policies of an organization.

India Based Cloud Computing Service Providers-

- **Zenith Infotech**

- **Wolf Frameworks**

- **OrangeScape**

- **TCS**

- **Cyanpse India**

- **Wipro Technologies**

- **Netmagic Solutions**

- **Reliance Data Center**

- **Infosys Technologies**

- **Synage**

Top players in cloud computing worldwide –

- **Cloud Expo**

- **3Leaf Systems**

- **3PAR, 3Tera**

- **10Gen**

- **Adaptivity**

- **Agathon Group**

- **Amazon EC2**

- **Apache Hadoop**

- **Appirio**

- **Azure**

- **Bluewolf, Boomi**

- **Box-Net**

- **Citrix**

- **Cloud9 Analytics, etc.**

UNIT-2

- **IaaS** – **In Infrastructure as a service (IaaS), cpu, grids or clusters, virtualized servers, memory, networks, storage and systems software are delivered as service.**

- **PaaS** – **Platform as a service (PaaS), provides virtualized servers on which users can run applications, or develop new ones, without having to worry about maintaining the operating systems, server hardware, load balancing or computing capacity.**

- **SaaS** – **Software as a service (SaaS) is software that is developed and hosted by the SaaS vendor and which the end user accesses over the internet. Unlike traditional applications that users install on their computer or servers, SaaS software is owned by the vendor and runs on computers in the vendor's data center.**

Example of Cloud Services

Application Service(SaaS) - MS Live/ExchangeLabs, IBM, Google Apps; Salesforce.com, Quicken Online, Zoho, Cisco

Application Platform(PaaS)- Google App Engine, Mosso, Force.com, Engine Yard, Facebook, Heroku, AWS

Server Platform(IaaS)- 3Tera, EC2, SliceHost, GoGrid, RightScale, Linode

Storage Platform(IaaS)- Amazon S3, Dell, Apple

Communication-as-a-Service (CaaS)

CaaS is an outsourced enterprise communications solution. Providers of this type of cloud-based solution (known as CaaS vendors) are responsible for the management of hardware and software required for **delivering Voice over IP (VoIP) services, Instant Messaging (IM), and video conferencing capabilities to their customers.** . CaaS is designed on a utility-like pricing model that provides users with comprehensive, flexible, and (usually) simple-to-understand service plans. CaaS service offerings are often bundled and may include integrated access to traditional **voice (or VoIP) and data, advanced unified communications functionality such as video calling, web collaboration, chat, real time presence and unified messaging, a handset, local and long-distance voice services, voice mail, advanced calling features (such as caller ID, three way and conference calling, etc.) and advanced PBX functionality.** A CaaS solution includes redundant switching, network, POP and circuit diversity, customer premises equipment redundancy, and WAN fail-over that specifically addresses the needs of their customers. All VoIP transport components are located in geographically diverse, secure data centers for high availability and survivability.

<u>Advantages of CaaS</u>

1. Hosted and Managed Solutions
2. No Capital Expenses Needed
3. Flexible Capacity and Feature Set
4. No Risk of Obsolescence
5. Fully Integrated, Enterprise-Class Unified Communications
   - Chat
   - Multimedia conferencing
   - Microsoft Outlook integration
   - Real-time presence
   - "Soft" phones (software-based telephones)
   - Video calling
   - Unified messaging and mobility

Monitoring-as-a-Service (MaaS)

Monitoring-as-a-Service (MaaS) is the outsourced provisioning of security, primarily on business platforms that leverage the Internet to conduct business. Since the advent of cloud computing, its popularity has, grown even more. **Security monitoring involves protecting an enterprise or government client from cyber threats. A security team plays a crucial role in securing and maintaining the confidentiality, integrity, and availability of IT assets.** However, time and resource constraints limit security operations and their effectiveness for most companies. This requires constant vigilance over the security infrastructure and critical information assets. MaaS security monitoring services offer real-time, 24/7 monitoring and nearly immediate incident response across a security infrastructure—they help to protect critical information assets of their customers. Prior to the advent of electronic security systems, security monitoring and response were heavily dependent on human resources and human capabilities, which also limited the accuracy and effectiveness of monitoring efforts. monitoring services can improve the effectiveness of a customer security infrastructure by actively analyzing logs and alerts from infrastructure devices around the clock and in real time.

Typical services provided by many MaaS vendors are described below.

- Early Detection

- Platform, Control, and Services Monitoring

- Intelligent Log Centralization and Analysis

- Vulnerabilities Detection and Management

- Continuous System Patching/Upgrade and Fortification

- Intervention, Forensics, and Help Desk Services

UNIT-4

Virtualization in Cloud Computing

Definition

Virtualization is the "creation of a virtual (rather than actual) version of something, such as a server, a desktop, a storage device, an operating system or network resources".

OR

A Hypervisor also known as Virtual Machine Monitor (VMM) can be a piece of software, firmware or hardware that gives an impression to the guest machines (virtual machines) as if they were operating on a physical hardware. It allows multiple operating system to share a single host and its hardware. The hypervisor manages requests by virtual machines to access to the hardware resources (RAM, CPU, NIC etc) acting as an independent machine.

In other words, Virtualization is a technique, which allows to share a single physical instance of a resource or an application among multiple customers and organizations. It does by assigning a logical name to a physical storage and providing a pointer to that physical resource when demanded.

What is the concept behind the Virtualization?

Creation of a virtual machine over existing operating system and hardware is known as Hardware Virtualization. A Virtual machine provides an environment that is logically separated from the underlying hardware.

The machine on which the virtual machine is going to create is known as **Host Machine** and that virtual machine is referred as a **Guest Machine**

Types of Virtualization:
1. Hardware Virtualization.
2. Operating system Virtualization.
3. Server Virtualization.
4. Storage Virtualization.

1) Hardware Virtualization:

When the virtual machine software or virtual machine manager (VMM) is directly installed on the hardware system is known as hardware virtualization.

The main job of hypervisor is to control and monitoring the processor, memory and other hardware resources.

After virtualization of hardware system we can install different operating system on it and run different applications on those OS.

Usage: Hardware virtualization is mainly done for the server platforms, because controlling virtual machines is much easier than controlling a physical server.

2) Operating System Virtualization:

When the virtual machine software or virtual machine manager (VMM) is installed on the Host operating system instead of directly on the hardware system is known as operating system virtualization.

Usage: Operating System Virtualization is mainly used for testing the applications on different platforms of OS.

3) Server Virtualization:

When the virtual machine software or virtual machine manager (VMM) is directly installed on the Server system is known as server virtualization.

Usage: Server virtualization is done because a single physical server can be divided into multiple servers on the demand basis and for balancing the load.

4) Storage Virtualization:

Storage virtualization is the process of grouping the physical storage from multiple network storage devices so that it looks like a single storage device.Storage virtualization is also implemented by using software applications.

Usage: Storage virtualization is mainly done for back-up and recovery purposes.

How does virtualization work in cloud computing?

Virtualization plays a very important role in the cloud computing technology, normally in the cloud computing, users share the data present in the clouds like application etc, but actually with the help of virtualization users shares the Infrastructure.

The **main usage of Virtualization Technology** is to provide the applications with the standard versions to their cloud users, suppose if the next version of that application is released, then cloud provider has to provide the latest version to their cloud users and practically it is possible because it is more expensive.

To overcome this problem we use basically virtualization technology, By using virtualization, all severs and the software application which are required by other cloud providers are maintained by the third party people, and the cloud providers has to pay the money on monthly or annual basis.
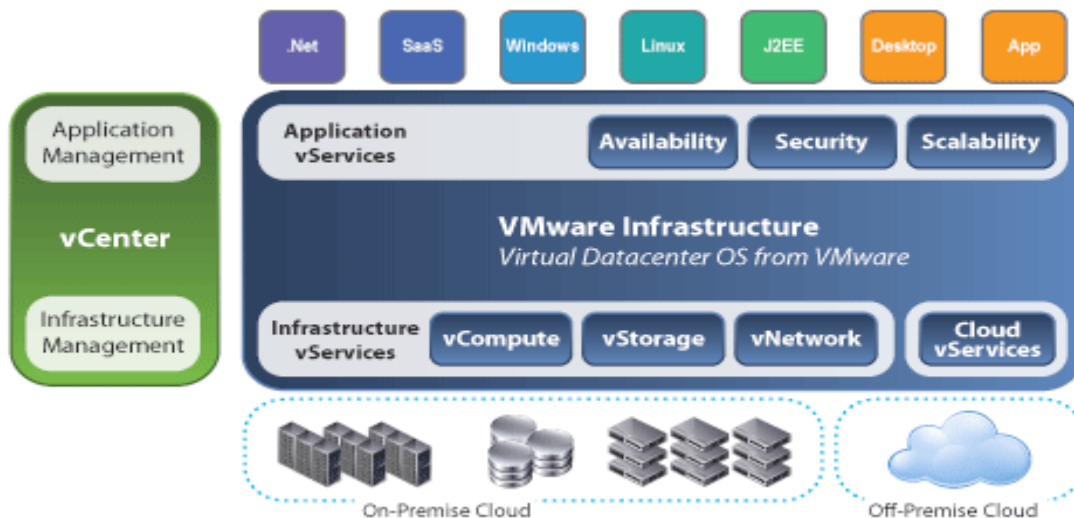
# **TYPES OF VIRTUALIZATION-TYPE -1 AND TYPE -2**

There are <u>two types of hypervisors</u>: Type 1 and Type 2.

Type 1 hypervisors run directly on the system hardware. They are often referred to as a "native" or "bare metal" or "embedded" hypervisors in vendor literature.

Type 2 hypervisors run on a host operating system. When the virtualization movement first began to take off, Type 2 hypervisors were <u>most popular</u>. Administrators could buy the software and install it on a server they already had.

Type 1 Hypervisor

- **This is also known as Bare Metal or Embedded or Native Hypervisor.**
- **It works directly on the hardware of the host and can monitor operating systems that run above the hypervisor.**
- **It is completely independent from the Operating System.**
- **The hypervisor is small as its main task is sharing and managing hardware resources between different operating systems.**
- **A major advantage is that any problems in one virtual machine or guest operating system do not affect the other guest operating systems running on the hypervisor.**
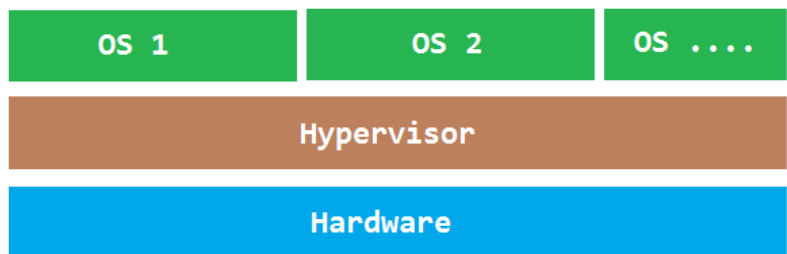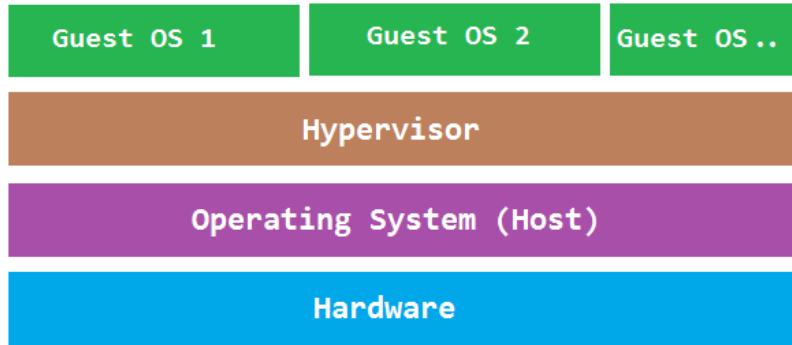

Examples:

VMware ESXi Server
Microsoft Hyper-V
Citrix Xen Server

Type 2 Hypervisor

- **This is also known as Hosted Hypervisor.**
- **In this case, the hypervisor is installed on an operating system and then supports other operating systems above it.**
- **It is completely dependent on host Operating System for its operations**
- **While having a base operating system allows better specification of policies, any problems in the base operating system affects the entire system as well even if the hypervisor running above the base OS is secure.**

Guest OS 1	Guest OS 2	Guest OS..
Hypervisor		
Operating System (Host)		
Hardware		

Examples:
VMware Workstation
Microsoft Virtual PC
Oracle Virtual Box