UNIT- III

Cloud Deployment Models:-

The concept of cloud computing has evolved from cluster, grid and utility computing. Utility and Software as a Service (SaaS) provide computing resources as a service with a notion of pay per use.

Cloud computing leverages dynamic resources to deliver large no. of services to end users.

Cloud computing:-

It is a High Throughput Computing (HTC) paradigm whereby the infrastructure provides services through a large data center or server farms. The cloud computing model enables users to share access to resources from anywhere at any time through their connected device.

All computations in cloud applications are distributed to servers in data center. Virtual Machines (VMs) in virtual clusters created out of data center resources.

Public cloud:

- It is built over Internet and can be accessed by any user who has paid for the service. Public Clouds are owned by service providers and are accessible through a subscription.

Public cloud providers:

- Google App Engine (GAE),
- Amazon Web Services (AWS)
- Microsoft Azure
- IBM Blue cloud.
- Salesforce.com.

- They were commercial providers that offer a publicly accessible remote interface for creating and managing VM instances within their proprietary infrastructure.

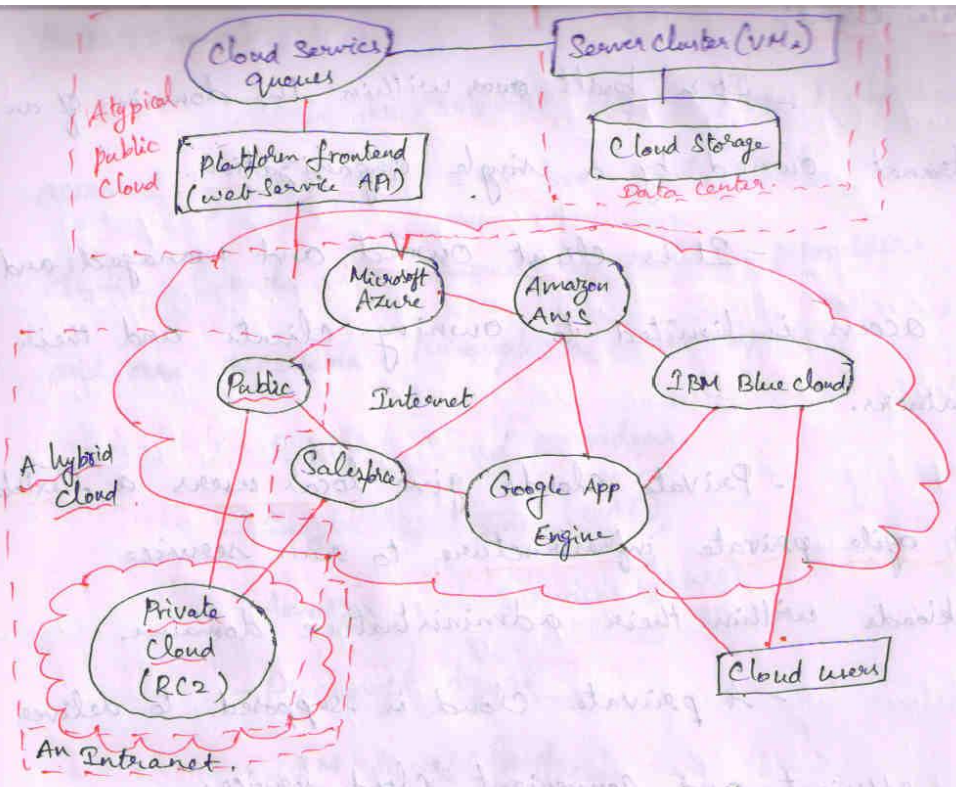
- A public cloud delivers a selected set of business processes. The Application and infrastructure services are offered on a flexible price per use basis.

Private cloud:

- It is built within the domain of an intranet owned by a single organization.
- It is client owned and managed and its access is limited to owning clients and their partners.
- Private clouds give local users a flexible and agile private infrastructure to run service workloads within their administrative domains.
- A private cloud is supposed to deliver more efficient and convenient cloud services.

Hybrid clouds:

- It is built with both public and private clouds.
- Private clouds can support a hybrid model by supplementing local infrastructure with computing capacity from an external public cloud.
- Research Compute cloude (RC2) developed by IBM to connect the computing, IT resources at eight IBM research centres..
- Hybrid clouds operate in the middle with many compromises interms of resource sharing.



Public, Private & Hybrid cloud.

Data Center Networking:-

- A core of the cloud is the server Cluster (VM cluster). Cluster nodes are used as Compute nodes. A few control nodes are used to manage and monitor cloud activities.

- Data center networks are mostly IP-based Commodity networks such as 10 Gbps which is optimized for Internet access.

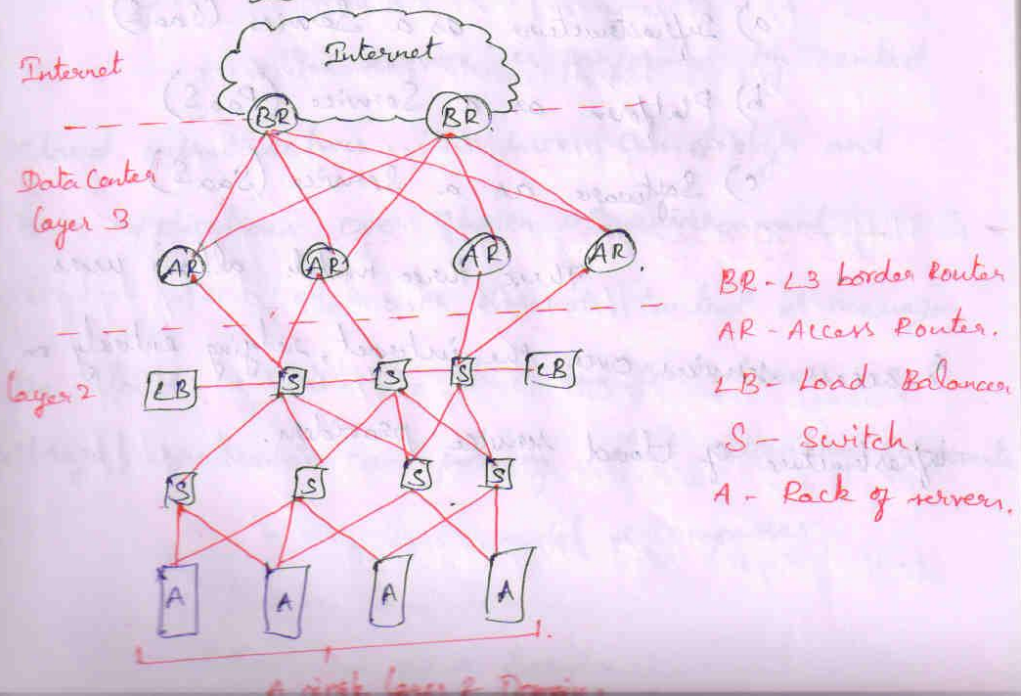
- The servers racks at bottom layer 2, they are connected through fast switches (S) as the hardware core.

- The datacenter is connected to Internet at layer 3 with many access routers (AR) and border routers (BR).

- The scheduling of user jobs requires that to assign work to virtual clusters created for users.

- The gateway nodes can also be used for security control for entire cloud. It also provides access points of the service from outside world.

Standard Data center Networking.



Cloud design Objectives:

There are six design objectives for Cloud computing.

(i) Shifting computing from desktops to datacenters.

(ii) Service provisioning and cloud economics.

(iii) Scalability in performance.

(iv) Data Privacy protection.

(v) High quality of cloud services.

(vi) New standards and interfaces.

Cloud Service Models at different Service levels:

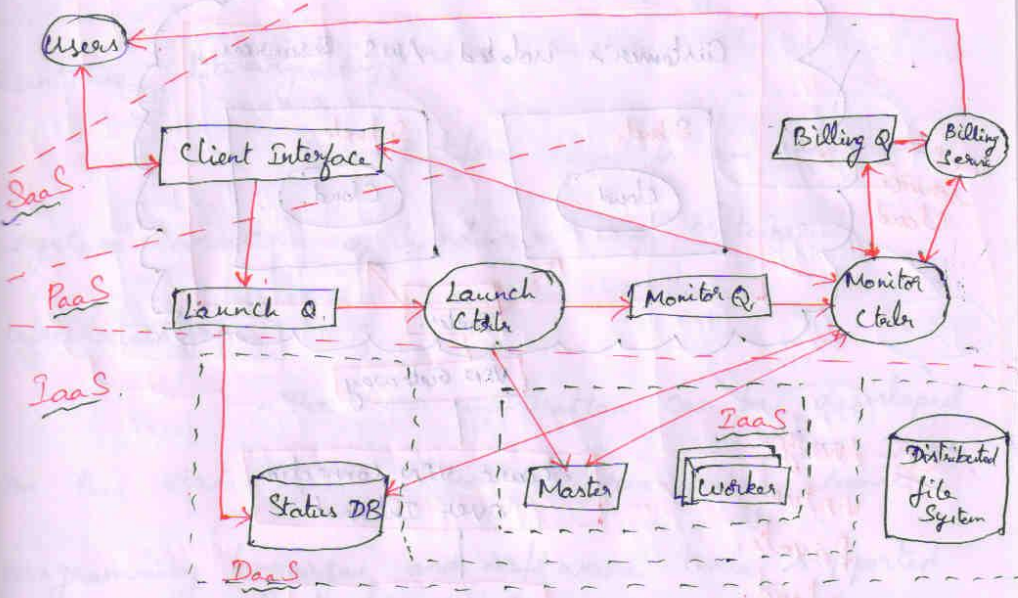
There were three different cloud service models. based on Subscription based services

a) Infrastructure as a Service (IaaS)

b) Platform as a Service (PaaS)

c) Software as a Service (SaaS)

These three models allow users to access services over the internet, relying entirely on infrastructure of cloud service providers.



a) Infrastructure as a Service (IaaS)

- This model allows users to use virtualised IT resources for computing, storage and networking.

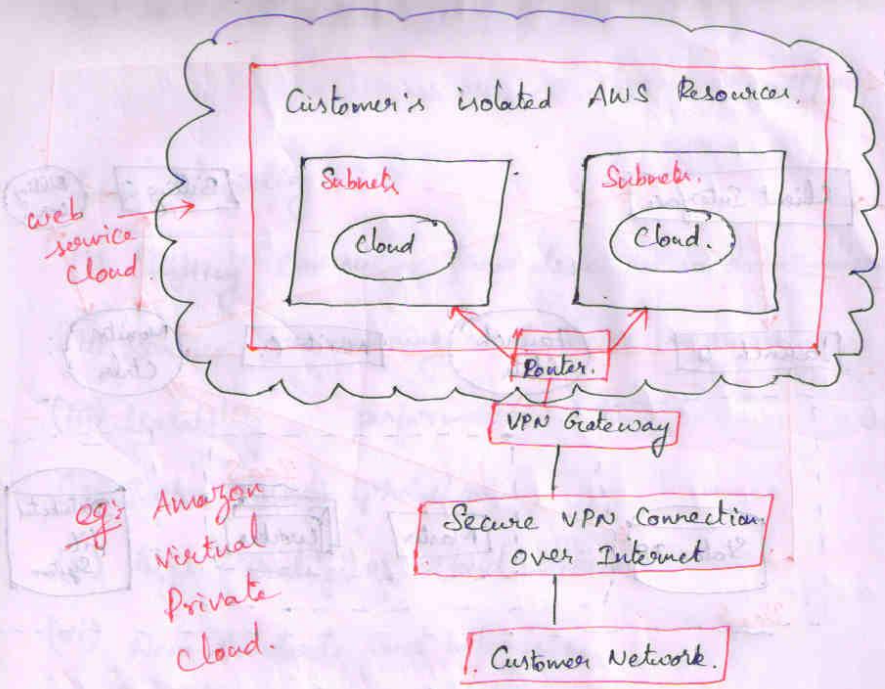
- The service is performed by rented cloud infrastructure. The user can deploy and run applications over chosen OS environment.

- The user doesnot control or manage the cloud infrastructure but has control over OS, storage, applications and possibly select networking components.

- This IaaS model encomparses

a) Storage as a Service.

b) Instances as a Service.



-The Cloud services are

a) resources from multiple data centers globally distributed.

b) web services (SOAP & Query)

c) web based console user interfaces.

d) Access to VM instances (via) SSH.

b) Platform as a Service :-

This model allows to develop, deploy and manage the execution of applications using provisioned resources demands a cloud platform with proper software environment.

- It includes operating system and runtime library support.

- The platform cloud is an integrated system consisting of hardware and software infrastructure.

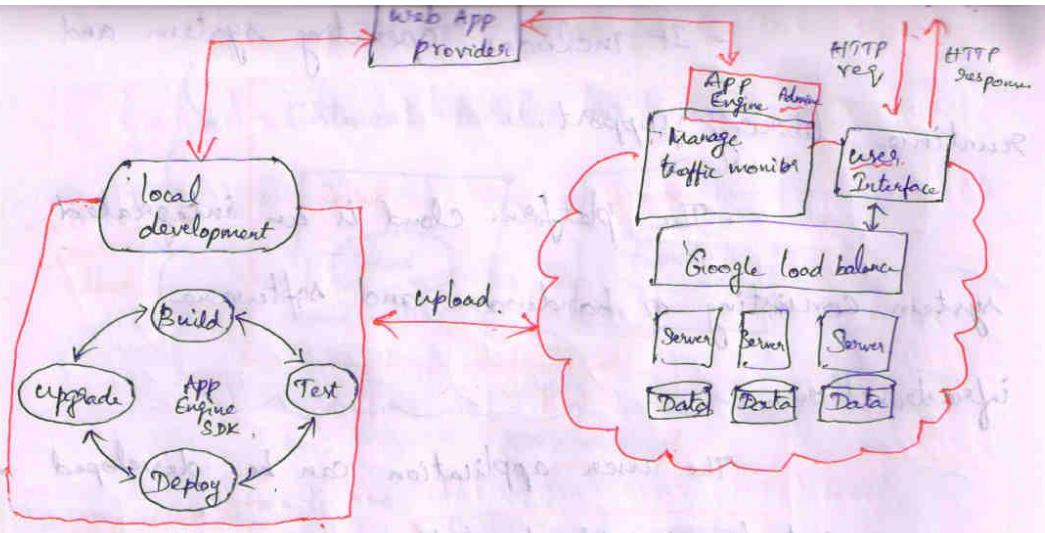
- The user application can be developed on this virtualized cloud platform using some programming languages and software tools supported by the provider.

- The user doesnot manage the underlying cloud infrastructure.

- The cloud provider supports user application development and testing a well defined service platform.

- This model enables software development platform for different users.

- It also encourages third parties to provide software management, integration and service monitoring solutions.



eg: Google App Engine

c) Software as a Service (SaaS)

- It is a browser initiated application software over thousands of cloud customers.

- On customer side, there is no upfront investment in servers or software licensing. On provider side, costs are low.

- Customer data is stored in the cloud whether it is vendor proprietary (or) publicly hosted to support PaaS and IaaS.

eg: Google Gmail and docs
Microsoft share Point
CRM from salesforce.com.

eg:- New york Times has applied Amazon EC2 and S3 services to retrieve useful pictorial information quickly from millions of articles and newspaper. The New york Times has significantly reduced the time and cost in getting the job done.

Implementation Levels of Virtualization:

2M) Virtualization:-

- It is a computer architecture technology by which multiple virtual machines (VM) are multiplexed in same hardware machine.

- The purpose of VM is to enhance resource sharing by many users and improve computer performance in terms of resource utilization and application flexibility.

- After Virtualization different users applications managed by their own OS can run on the same hardware independent of host OS. This can be done by adding software layer called virtualization layer.

- Virtualization layer is also known as hypervisor (or) Virtual Machine Monitor. (VMM)

- The main fn. of this layer is to virtualize the physical hardware of a host machine into virtual resources to be used by VMs.

- The Virtualization layer includes.

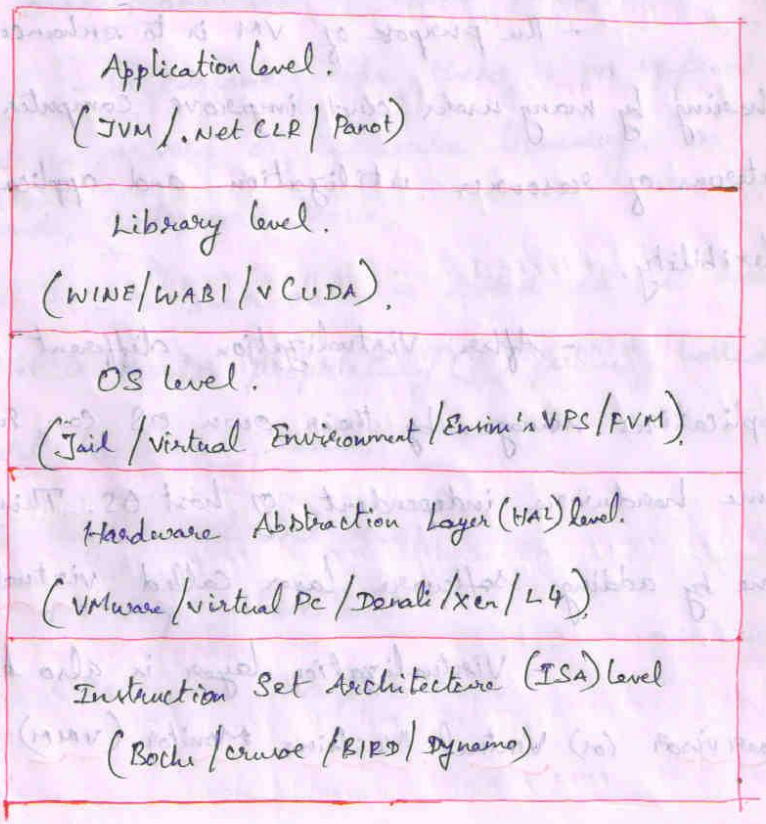
a) Instruction Set Architecture (ISA) level.

b) Hardware Abstraction layer (HAL) level.

c) Operating System level.

d) Library (user-level API) level.

e) Application level.



a) Instruction Set Architecture level.

- Virtualization is performed by emulating a given ISA by the ISA of the host machine.

- It is possible to run a large amount of legacy binary code written for various processors on any given new hardware host machines.

- Instruction set emulation leads to virtual ISA's created on any hardware machine.

- There were two methods (or) approaches.

(i) Code Interpretation.

(ii) Dynamic Binary Translation.

(i) Code interpretation:

- is a basic emulation method. An interpreter program interprets the source instructions to target instructions one by one. One source instructions requires hundreds of target instructions to perform its function. So this process is slow.

(ii) Dynamic Binary Translation:

- it translates the basic blocks of dynamic source instructions to target instructions. The basic block can also be extended to program

traces (or) super blocks to increase translation efficiency.

- Instruction set emulation requires binary translation and optimization.

- Virtual-Instruction set architecture (V-ISA) requires adding a processor specific software translation layer to the compiler.

b) Hardware Abstraction level.

- it is performed on top of bare hardware

- This approach generates a virtual hardware environment for a virtual Machine.

- The process manages the underlying hardware through Virtualization.

- The intention is to upgrade the hardware utilization rate by multiple users concurrently.

c) Operating System level:

- refers to an abstraction layer between OS and user applications.

- OS level virtualization creates isolated containers on a single physical server and OS

instances to utilize the hardware and software in data centers.

- The containers behave like real servers.
- This level is used in creating virtual hosting environments to allocate hardware resources among a large number of mutually distrusting users.

d) Library Support Level:

- Most applications use API exported to user level libraries rather than lengthy system calls.
- Virtualization with library functions (or) interfaces is possible by controlling the communication link between applications and rest of system through API hook.
- Eg: VCUDA

e) User Application Level:

- Application level virtualization is also known as process level virtualization.
- The popular approach is to deploy High level language (HLL) VMs.
- The virtualization layer sits as an application program on top of operating system and the layer exports an abstraction of VM that can run

program written and Compiled to a particular abstract machine definition.

- The other form of Application level virtualization are

(i) Application Isolation.

(ii) Application Sandboxing (or) Streaming.

- The process involves wrapping the application in a layer that is isolated from the host OS and other applications. The result in an application is easier to distribute and remove from user workstations.

b) VMM Design requirements and providers:

Virtual Machine Monitor:-

- It manages the hardware resources of a computing system. Each time programs access the hardware, the VMM captures the process. So VMM acts as traditional OS.

- There were three requirements for VMM they are

(i) It should provide an environment for programs which is essentially identical to original machine.

(ii) programs run in this environment show at worst only minor decreases in speed.

(iii) VMM should be in complete control of the system resources.

- The hardware resource requirements such as memory of each VM are reduced, but the sum of them is greater than that of real machine installed.

- To generate the efficiency of a VMM, a statistically dominant subset of virtual processors instructions need to be executed directly by real processor with no software intervention by the VMM.

- The complete control of resources involves three main aspects.

(i) The VMM is responsible for allocating hardware resources for programs.

(ii) It is not possible for a program to access any resource not explicitly allocated to it.

(iii) To regain control of resources already allocated.

c) Virtualization support at OS level:

- The hardware level virtualization issues arises such as.

(i) storing VM images.

(ii) full virtualization at hardware level.

- leads to slow performance, low density.

- To solve these issues, OS level virtualization is needed.

- OS virtualization inserts a virtualization layer inside an operating system to partition a machine's physical resources. It enables multiple isolated VMs within a single Operating system kernel. This kind of VM is called as Virtual Execution Environment (VEE), Virtual Private system (VPS).

- Advantages of OS Extensions (or) virtualization.

(i) Minimal startup/shutdown cost.

(ii) low resource requirement.

(iii) high scalability.

(iv) Synchronize state changes when needed.

- It is also known as Single OS image virtualization.

- Disadvantages :

(i) all the VMs at Operating System level on a single container must have the same kind of guest OS.

(ii) Isolated execution environment should be created based on a single OS kernel.

- Two ways to implement Virtual root directories, they are.

a) duplicating common resources to each VM partition.

b) Sharing most resources with host environment and only create private resource copies on the VM on demand.

d) Middleware support for Virtualization :

- Library level virtualization is also known as user level Application Binary Interface (ABI) or API emulation.

- This type of virtualization can create execution environment for running alien programs on a platform rather than creating a VM to run the entire Operating system.

- API call interception and re-mapping are the key functions performed.

a) WABI

- offers middleware to convert windows system calls to Solaris system calls.

b) Lxrun

- is really a system call emulator that enables LINUX applications written for x86 hosts to run on Unix systems.

c) WINE

- offers library support for virtualizing x86 processors to run windows applications on Unix hosts.

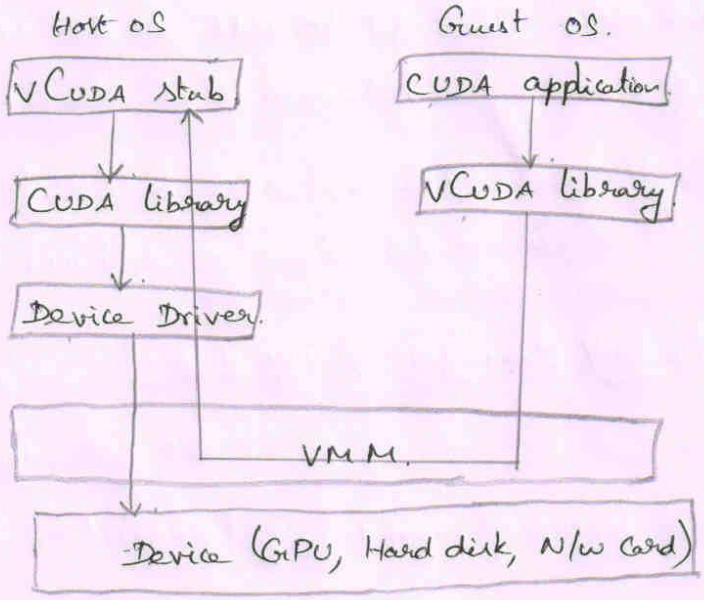
d) Visual MainWin

- offers a compiler support system to develop window application using visual studio to run on some Unix hosts.

e) vCUDA.

- Virtualization support for using general purpose GPUs to run data intensive applications under a special guest OS.

vCUDA Architecture:-



CUDA is a programming model and library for general purpose GPUs. It leverages the high performance of GPU to run compute-intensive applications on host Operating Systems.

vCuda employs a client server model to implemat CUDA virtualization. It consists of three user space component.

a) vCUDA library.
b) a Virtual GPU in guest OS.
c) vCUDA stub in the host OS.