~~Cloud~~ INTRODUCTION

UNIT-1

① Historical Developments -

Five core technologies that played an important role in the realization of cloud computing. These technologies are -

(1) Distributed System -

It is a collection of independent computers that appears to its users as a single coherent system. Various properties are heterogeneity, openness, scalability, transparency, concurrency, availability and independent failures.

*** Three major milestones have led to cloud computing that is mainframe computing, cluster computing and grid computing

(2) Virtualization -

It allows creation of different computing environments. These environments are called virtual because they simulate the interface that is expected by a user. Eg - Hardware virtualization, storage virtualization and network virtualization (VMWare, VCloud, RightScale)

(3) Web 2.0 -

The Web is transformed into a rich platform for application development which is known as Web 2.0. It brings interactivity and flexibility into Web pages, providing enhanced user experience using different technologies such as XML, Asynchronous Javascript.. AJAX etc. Eg - Facebook, Youtube, Wikipedia etc.

(4) Service Oriented Computing -

It supports the development of rapid, low-cost, flexible, interoperable and evolvable applications and systems.

A service is supposed to be loosely coupled, reusable, programming language independent and location transparent.

Two important concepts of service-oriented computing are -

(i) Quality of service (QoS) identifies a set of functional & non functional attributes that can be used to evaluate the behaviour of a service from different prospectives.

(ii) Software as a Service (SaaS) is inherited from ASPs (application service providers).

(5) Utility-Oriented Computing -

It is a vision of computing that define a service-provisioning model for compute services in which resources such as storage, compute power, applications and infrastructure are packed and offered on a pay-per-use basis.

(2) Vision of cloud computing -

Cloud computing allow anyone with a credit card to provision virtual hardware, runtime environments and services.

The long term vision of cloud computing is that IT services are traded as utilities in an open market, without technological and legal barriers.

(National Institute of Standards and Technology)

(3) Characteristics of cloud computing as per NIST -

Five essential characteristics of cloud computing are -

(1) On-demand self service -

Compute services can be provided without requiring interaction with service provider.

(2) Broad Network Access -

Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms. Eg - mobile phones, tablets, laptops etc.

(3) Resource Pooling -

The providers computing resources are pooled together to serve multiple customers, with different physical and virtual resources dynamically assigned and reassigned according to the customer demand without control or knowledge over the exact location of provided services.

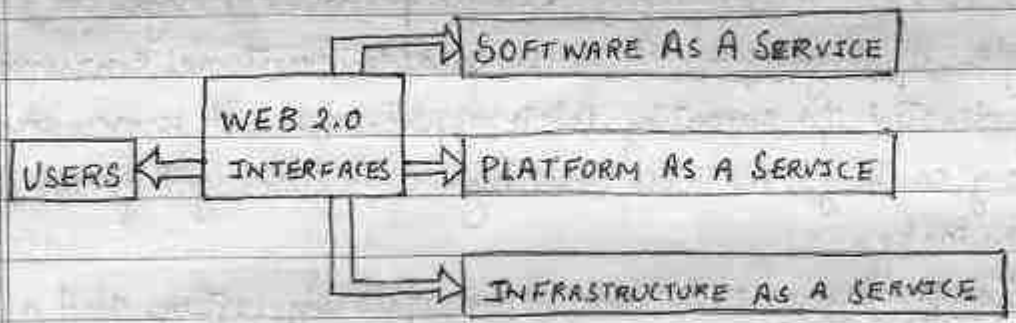
(1) Rapid Elasticity -

Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand.

(5) Measured service -

Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service.

(4) Cloud computing reference model -



IaaS - It delivers infrastructure on demand in the form of virtual hardware, storage and networking. Eg - vCloud, S3.

PaaS - It delivers scalable and elastic runtime environment on demand and host the execution of applications. Eg. - Azure, Hadoop.

SaaS - It provides applications and services such as social networking, photo editing, office automation etc. Eg - Facebook, Salesforce.

(5) Cloud computing Environments -

It encompasses both the development of applications and systems that leverage cloud computing solutions and the creation of frameworks, platform and infrastructures delivering cloud computing services.

Application development -

Cloud computing benefit from its capability to dynamically scale on demand. Various application are web applications, enterprise applications, resource-intensive application and scientific applications.

Infrastructure and System development -

Core technologies are distributed computing, virtualization, service orientation and Web 2.0.

Computing platforms and Technologies -

(1) Amazon Web Services (AWS) - provides IaaS services. "AWS is mostly known for its compute and storage-on-demand services such as - Elastic Compute Cloud (EC2) provides users with customizable virtual hardware that can be used as the base infrastructure for deploying computing systems on the cloud.
Simple Storage Service (S3) delivers persistent storage on demand.

(2) Google AppEngine - It is a scalable runtime environment mostly devoted to executing Web applications. It services include in-memory caching, scalable ~~and high~~ data store, job queues, messaging and cron tasks.

(3) Microsoft Azure - It is a cloud operating system and a platform for developing application in the cloud. It provides web role, worker role and virtual machine role.

(4) Hadoop - Apache Hadoop is an open source framework that is suited for processing large data sets on commodity hardware. It provides runtime environment, and developers need only provide the input data and specify the map and reduce functions that need to be executed.

(5) Force.com and Salesforce.com -

Force.com is a cloud computing platform for developing social enterprise applications. The platform is the basis for Salesforce.com, a SaaS solution for customer relationship management.

(6) Manjrasoft Aneka - It is cloud application platform for rapid creation of scalable applications and their deployment on various types of clouds in a seamless and elastic manner.

(6) Cloud Services Requirements -

A proven service management system to provide visibility, control and automation across services to help accelerate standardization, rapid client payback on investment.

Various IT service management are knowledgement management, service request, asset lifecycle manager, self service portal, Policy & compliance, service level management, responsibility and dashboard, process manager, change and release, incident and problem, service catalogue, configuration management and event management

⑦ Cloud and Dynamic Infrastructure -

Cloud computing is dynamic in nature. It allows client to access standardized IT resources to deploy new applications, services or computing resources rapidly without reengineering their entire infrastructure, thus making it dynamic.

Cloud Dynamic Infrastructure provides the following features -

(1) Service Management - that is IaaS, PaaS, SaaS which manages IT services which includes visibility, automation and control to delivering the first class IT services.

(2) Asset Management - The assets or the property which is involved in providing the cloud services are getting managed in such a way so that their value will got maximized.

(3) Virtualization and Consolidation - Resources are getting utilized more and more efficiently and also the operating cost of the systems is getting down.

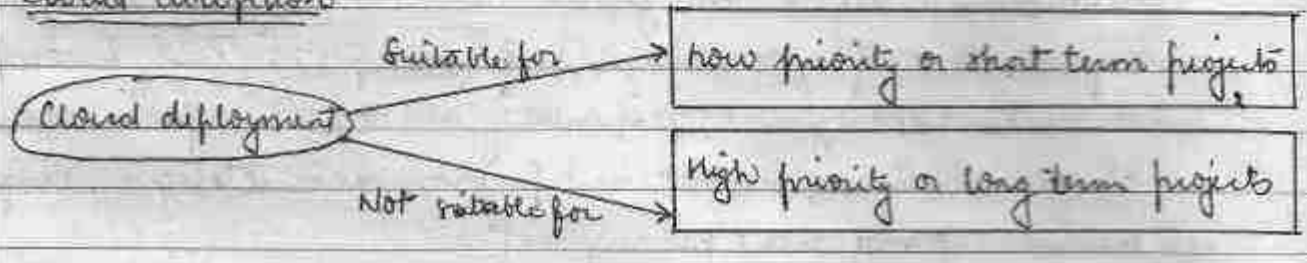
(4) Information Infrastructure - It helps the business organizations to achieve information compliance, availability of resources retention and security objectives.

(5) Energy - Efficiency - IT infrastructure or organization is sustainable. It means it is not likely to damage or effect any other thing.

(6) Security - This cloud infrastructure is responsible for the risk management and customizing the governance (administration).

(7) Resilience - Infrastructure is safe from all side. The IT operations will not be easily get affected.

(8) Cloud adoption -

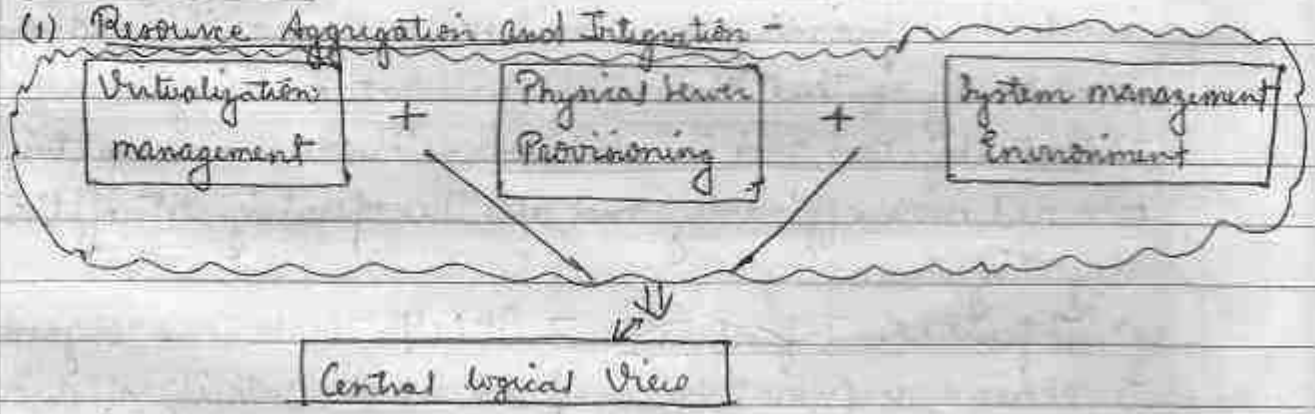


Cloud adoption is suitable for -
(1) low availability requirement and short life spans
(2) no recovery management, backup recovery based implementations
(3) modular and loosely coupled applications.
(4) Research and development projects

Cloud adoption is not suitable for -
(1) Goal-critical applications.
(2) Core business applications
(3) Data sensitive applications

(9) Cloud Rudiments - (essential)

(1) Resource Aggregation and Integration -



Cloud solution integrates or aggregates the information of these 3 resources and after that the integrated information will be sent into a central logical view.

(2) Application services -

→ The application instances represents the agreement between service provider and the consumer to use services on On-Demand basis.

→ Reservation of resources means that it is guaranteed that at a given point of time the resources or the services will surely available for consumer.

(3) Self-service portal -

Users can request machine or entire multi-machine environments and monitor and control them using a web-based self-service portal.

(4) Allocation Engine -

The Dynamic Resource Management (DRM) provides the automated allocation and reallocation of resources.

DRM maximize the efficiency of IaaS.

(5) Reporting and Accounting -

The actual resource allocation and the actual cloud usage will be get recorded or collected in an accounting database.

The data will be available centrally to create reports of usage.

Cloud Features →

- Dynamic Workload Management -

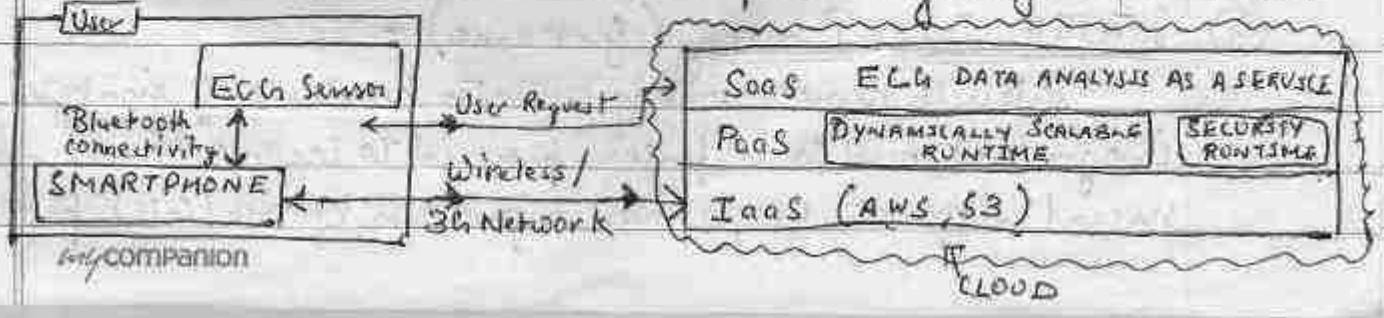
Cloud virtual machines are enabled with automated softwares that control the workflow request and also enabled with a lifecycle that increase the effective utilization of resources.

Overview of Cloud Application -

① ECG analysis in the cloud (Healthcare) -

The remote monitoring of a patient's heartbeat data, data analysis in minimal time, and the notification of first-aid personnel and doctors should these data reveal potentially dangerous conditions.

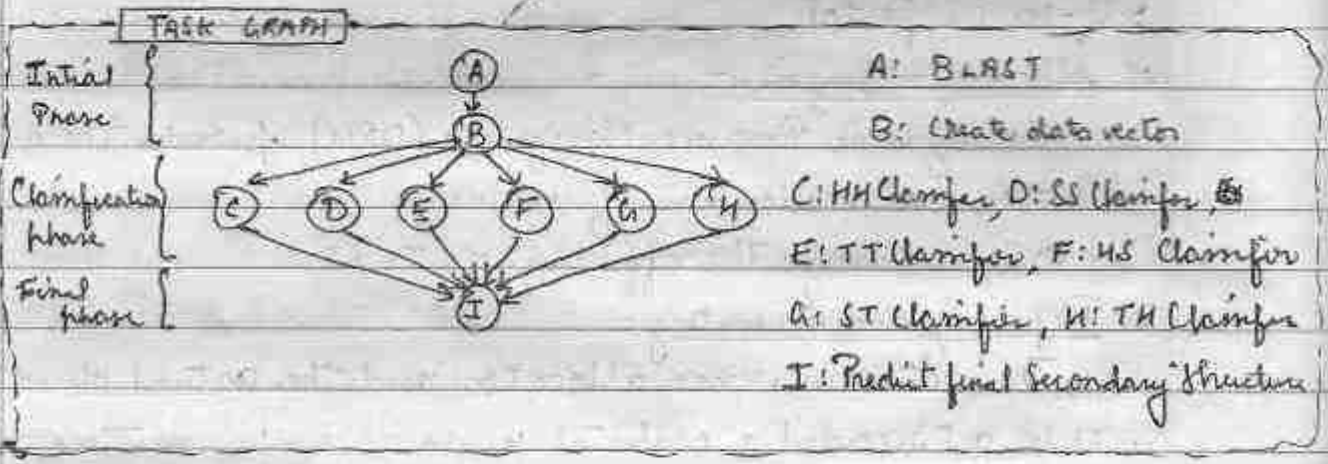
e.g.-



Orchestrator is a workflow management solution for the data center.

② Protein Structure Prediction (Biology) -

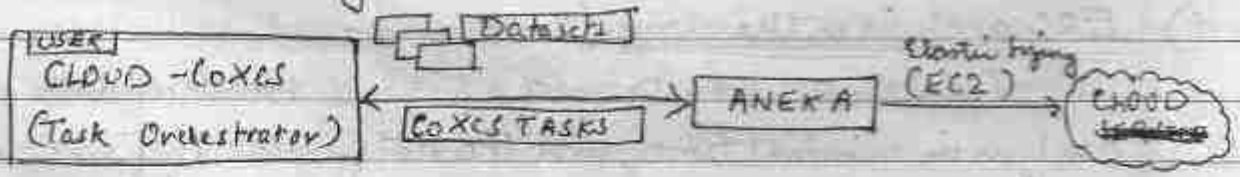
It is computationally intensive task that is fundamental to different types of research in the life sciences. This task requires the investigation of a space with a massive number of states, consequently creating a large number of computations for each of these states. Eg - Jeeva Portal.



③ Gene Expression Data analysis for cancer diagnosis (Biology) -

It is used to understand the biological process that are triggered by medical treatment at a cellular level.

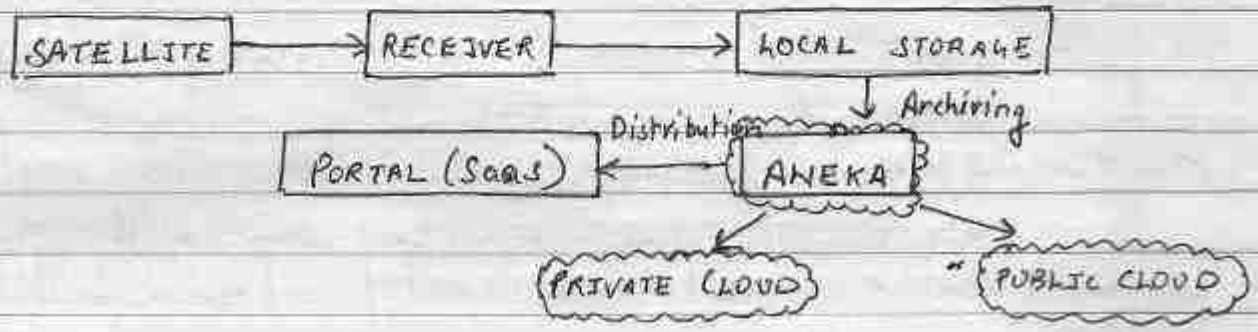
Extended Classifier System (XCS) has been successfully utilized for classifying large data sets in the bioinformatics and computer science domains. Eg - Cloud-CoXCS.



④ Satellite Image Processing (Geoscience) -

Satellite remote sensing generates hundreds of gigabytes of raw images that need to be further processed to become the base of several different Geographic Information System (GIS) products.

Eg -



(5) CRM and ERP -

CRM → Customer Relationship Management

ERP → Enterprise Resource Planning

Cloud CRM applications constitute a great opportunity for small enterprises and start-ups to have a fully functional CRM software without large up front cost & by paying subscriptions.

ERP integrates several aspects of an enterprise - finance and accounting, human resources, manufacturing, supply ~~change~~ chain management, project management and CRM.

CRM examples - Salesforce.com, Microsoft Dynamics CRM, Netsuite Global CRM+

ERP example - Netsuite Global ERP.

(6) Social Networking -

To sustain their traffic and serve millions of users seamlessly, services such as Twitter and Facebook have leveraged cloud computing technologies. The possibility of continuously adding capacity while systems are running is the most attractive feature for social networks, which constantly increase their user base.

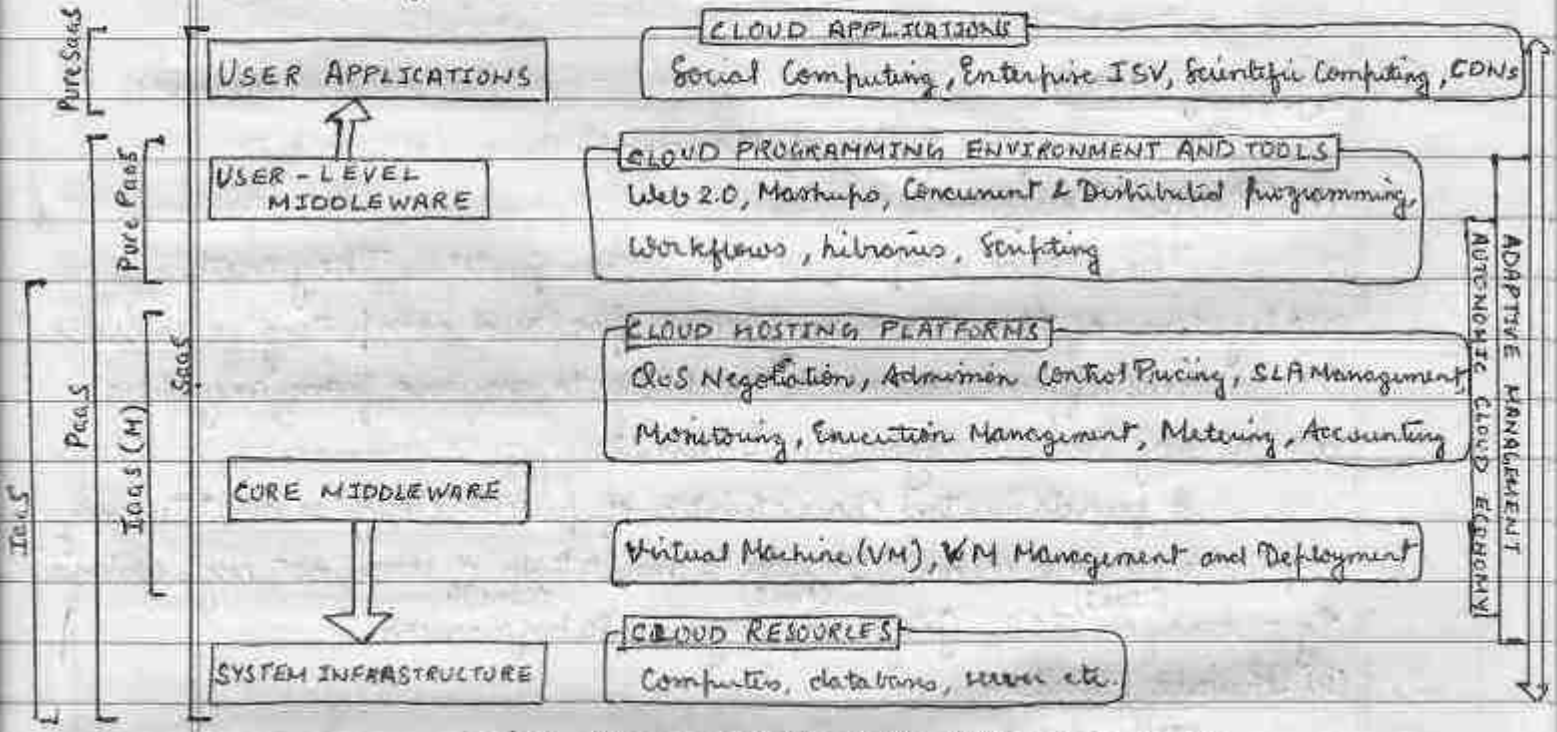
IaaS(M) :→ M stands for management layer

Date ___/___/___
Page ___

UNIT-II

CLOUD COMPUTING ARCHITECTURE -

① Cloud Reference Model -



THE CLOUD COMPUTING ARCHITECTURE

There major categories used to classify cloud computing solutions are -

(1) SaaS -

Characteristics - Customer are provided with applications that are accessible anytime and from anywhere.

Product type - Web applications and services (Web 2.0)

Vendors and Products - SalesForce.com (CRM), Clarizen.com (project management), Google apps.

(2) PaaS -

Characteristics - Customers are provided with a platform for developing applications hosted in the cloud.

Product type - Programming APIs and frameworks development systems

Vendors & Products - Google AppEngine, Microsoft Azure, Data Synapse, Manjrasoft Aneka

(3) IaaS / HaaS -

Characteristics - Customers are provided with virtualized hardware and storage on top of which they can build their infrastructure.

Product type - Virtual Machine Management, Infrastructure Storage Management, Network Management.

Vendors and Products - Amazon EC2 and S3, Go Grid, Nirvanix.

② Types of Clouds -

There are four types of clouds.-

(1) Public Clouds -

The cloud is open to the wider public. They are a realization of the canonical view of cloud computing in which the services offered are made available to anyone, from anywhere, and at any time through the Internet.

A fundamental characteristic of public clouds is multitenancy. A public cloud is meant to serve a multitude of users, not single customer.

Eg - Amazon EC2 (IaaS), Google AppEngine (PaaS), Salesforce.com (SaaS)

(2) Private Clouds -

The cloud is implemented within the private premises of an institution and generally made accessible to the members of the institution or a subset of them.

Key advantages of using a private cloud are Customer Information Protection, Infrastructure ensuring SLAs (Service level Agreements) and Compliance with standard procedures & operations.

Eg - DataSynapse, Zimory Pools, Elastra and Aneka → PaaS

Eg VMWare, vCloud, KVM, Xen, OpenPEX, InterGrid → IaaS(M)

(3) Hybrid Clouds / Heterogeneous Clouds -

The cloud is a combination of public cloud and private cloud. It is most likely identifies a private cloud that has been augmented with resources or services hosted in a public cloud.

Key characteristic of hybrid cloud is dynamic provisioning which refers to the capability to acquire on demand virtual machines in order to increase the capability capability of the resulting distributed system and then release them.

Eg - OpenNebula, InterGrid, Aneka, Elastra CloudServer and Zimory Pools

(4) Community Clouds -

The cloud is characterized by a multi-administrative domain involving different deployment models (public, private and hybrid), and it is specifically designed to address the needs of a specific industry.

Benefits of community clouds are openness, community, (no single point of failure) graceful failures, convenience and control and environmental sustainability.

Eg - Media Industry, Healthcare Industry, public sector, scientific research, energy and other core industries etc.

(3) Cloud Interoperability and Standards -

Cloud computing is a service-based model for delivering IT Infrastructure and applications like utilities such as power, water and electricity. To fully realize this goal, introducing standards and allowing interoperability between solutions offered by different vendors are objectives of fundamental importance.

Vendor lock-in constitutes one of the major strategic barriers against the seamless adoption of cloud computing at all stages.

Open Challenges for industry and media

Open Virtualization Format (OVF) is an attempt to provide a common format for storing the information and metadata describing a virtual machine image.

A standardization process have been made by few organizations that are Cloud Computing Interoperability Forum (CCIF), the Open Cloud Consortium, and the DMTF Cloud Standards Incubator.

(4) Scalability and Fault Tolerance -

The ability to scale on demand beyond the limits of the existing in-house IT resources is known as cloud scalability. Various dimensions are performance, size and load.

The challenge in this case is designing highly scalable & fault-tolerant systems that are easy to manage & at the same time provide competitive performance

SOA = Service oriented architecture.

CLOUD SOLUTIONS –

① Cloud Ecosystem –

It is a term used to describe the complete system of interdependent components that work together to enable cloud services.

In cloud computing, complete includes not only traditional elements of cloud computing such as software and infrastructure but also consultants, integrators, partners, third parties and anything in their environments that has a bearing on other components

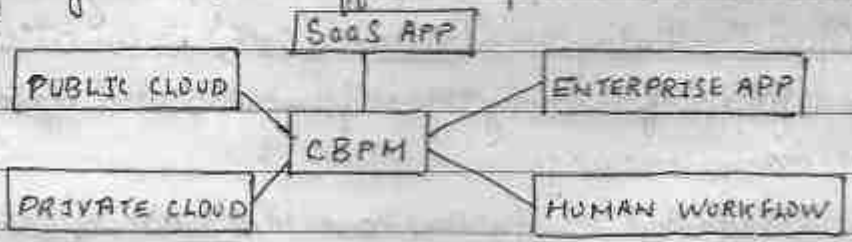
BUSINESS PROCESS (SOA)	Consultants, Integrators, partners, third parties.
APPLICATION SERVICES	Information, Visualization, Commerce, Accessibility
PLATFORM SERVICES	Device, Security, BOS, Collaboration, Utilities
INFRASTRUCTURE SERVICES	Standards, Tools, Server, Storage, Network

CLOUD COMPUTING ECOSYSTEM

② Cloud Business Process Management (CBPM) –

BPM governs an organization's cross functional, customer-focused, end-to-end core business processes.

Its objective is to direct and deploy resources from across the organization into efficient process that create customer value.



The cloud environment could help BPM by –

(1) Integration of core process (2) Value focused efficiency
(3) Continuous Improvement (4) Cultural

③ Cloud Service Management –

It includes all of the service related functions that are necessary for the management and operation of those services required by or proposed to cloud consumers.

It can be described from the perspective of –

(1) Business Support -

It involves the set of business-related services dealing with client and supporting processes. It includes customer management, contract management, inventory management, accounting and billing, reporting and auditing and pricing and billing rating.

(2) Provisioning and Configuration -

It includes rapid provisioning, resource changing, monitoring and reporting, metering and SLA (Service level Agreement) Management.

(3) Portability and Interoperability -

Portability - Customers are interested to know whether they can move their data or applications across multiple cloud environments at low cost and minimal disruption.

Interoperability - User are concerned about the capacity to communicate between or among multiple clouds.

CLOUD OFFERINGS -

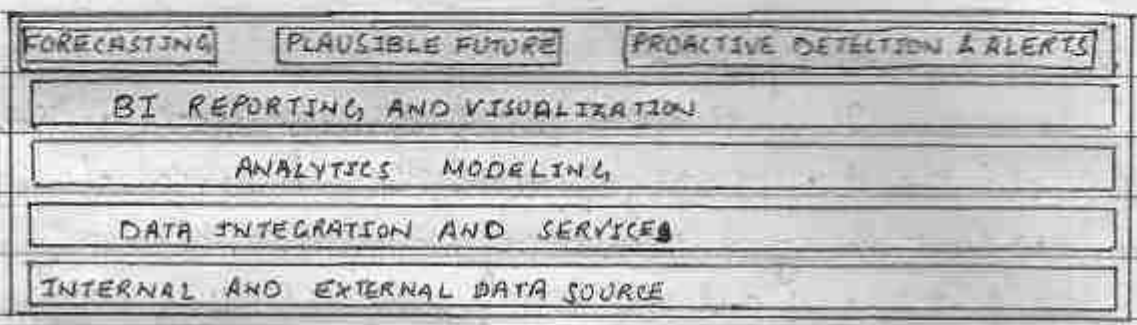
(1) Cloud Analytics -

It provides user with better forecasting techniques to analyze and optimize the service lines and provides a higher level of accuracy.

There are six elements of analytics that is data source, data model, processing applications, computing power, analytic models and sharing or storage of results.

Cloud analytics is also called SaaS-based Business Intelligence (BI), Eg - hosted data warehouses, Cloud based social media analytics etc.

Cloud analytics combine some or all the service models of cloud in delivering the solution.



CLOUD ANALYTICS

Cloud Business Analytics Competencies are -

(1) Cloud Business Analytic Strategy
(2) Business Intelligence and performance management
(3) Analytics and Optimization
(4) Enterprise Information Management

② Testing Under Cloud - ~~It test~~.

Testing under the cloud environment gives a good insight by decreasing the manual intervention and reducing the process in typical testing environment. By enabling access to resources and also when required, it reduces the cost, reduces test cycle, rationalize the testing environment and improve the service quality.

→ Four major objectives of cloud testing are -

(1) To assure the quality of cloud based applications
(2) To validate SaaS in a cloud environment
(3) To check the provided automatic cloud based functional services.
(4) To test cloud compatibility and interoperation ~~between~~ ~~of~~ capability between SaaS and applications.

→ Advantages of Cloud based testing are

(1) Cost reduction regarding the quality of cloud.
(2) Test Cycle Time can be minimized
(3) less time spent on test environment creation.
(4) Helps to perform large scale and real time online validations for internet based software in clouds due to on-demand test services

③ Virtual Desktop Infrastructure (VDI) -

VDI provides end-user virtualization solutions. This is designed to help transform distributed IT architectures into virtualized, open-standard-based framework leveraging centralized IT services.

The notion behind the virtual desktop infrastructure is to run ~~desktop~~ desktop operating systems and applications inside virtual machines that reside on the servers in the data center. This is called virtual desktop. User access a virtual desktop though their desktop PC.

VDI ARCHITECTURE

The VDI architecture consists of Endpoint devices, the connection broker and VM hosting servers.

Advantages of VDI are-

(1) Cost Reduction
(2) Flexibility
(3) Security
(4) Availability
(5) Efficiency
(6) Rapid client development

VDI provides a enterprise level or grade solution. It introduces a new method of delivering and managing user desktop environments

Virtual Desktop Manager (VDM) helps user to connect their desktop to severs.

Date __/__/__
Page _____

UNIT-III

CLOUD MANAGEMENT-

① Resiliency -

It is the capacity to rapidly adapt and respond to risks, as well as opportunities. This maintains continuous business operations that support growth and operate in potential adverse conditions.

→ Cloud resilience services are -

(1) Systematically and automatically backup data which increases availability and recovery rates in a adverse situation.

(2) Archiving documents which improves the efficiency of storing and retrieving information as needed, whether of regulatory compliance or business need.

(3) Enable faster recovery of application without the high cost

→ Resiliency Capabilities -

The framework combines multiple parts to mitigate risks and improve business resilience -

(1) From a facilities perspective, you may need to implement power protection

(2) From security perspective, to protect applications and data

(3) From process perspective, you may implement identification and documentation of most critical business process.

(4) From organizational perspective, geographical diversity, backup of ~~data~~ workstation data

(5) From strategy and vision perspective, you would want to have a crisis management.

② Provisioning - (means to provide)

Cloud provisioning is the process of allocating a cloud provider's resources to the customer.

Whenever a cloud provider accepts the customer request, it needs to establish the appropriate number of VMs and allocate resources for supporting them. This process is carried out in three way -

(1) Dynamic Provisioning - In this the provider allocates more resources as per requirement and removes them when they are not needed. The customer

is charged according to pay-per-use basis. If this dynamic provisioning is used to create a hybrid cloud, then it is referred as cloud bursting.

(2) Advance Provisioning - In this the customer undertakes a contract with the provider for the agreed service and the cloud provider arranges the appropriate resources before beginning the service. The customer is billed a flat fee or on a monthly basis.

(3) User Self-provisioning (Cloud self service) - In this process the customer purchases the required resources from the provider with the help of a web form by creating a customer account and then paying for the resources through credit card. The cloud provider's resources are made available for customer use within a span of a few hours.

(3) Asset Management -

This task is to manage all the assets, such as network, hardware and software that makes the cloud infrastructure. The main aim of asset management is to secure organizational assets.

Asset management strategy includes -

(1) Software Packaging - The output from software package will be used during the installation and configuration of the various software package requested by customer.

(2) Incident Management - Used to track any interruptions or issues to the asset management service.

(3) Pool Management - It works with asset management to make sure that the products requested are available on the requested date and for specified duration.

(4) System Management - It is both a process and a service. In order to interface with asset management, it provides all of the information on what attributes of OS, middleware components need to be managed.

(5) Release Management

(6) Configuration Management -

(7) Backup Management

④ Concepts of MapReduce -

MapReduce is a software framework that allows developers to write programs that process massive amounts of unstructured data in parallel across a distributed cluster of processors or stand-alone computers. It was developed by Google for indexing web pages and replace their original indexing algorithms and heuristics in 2004.

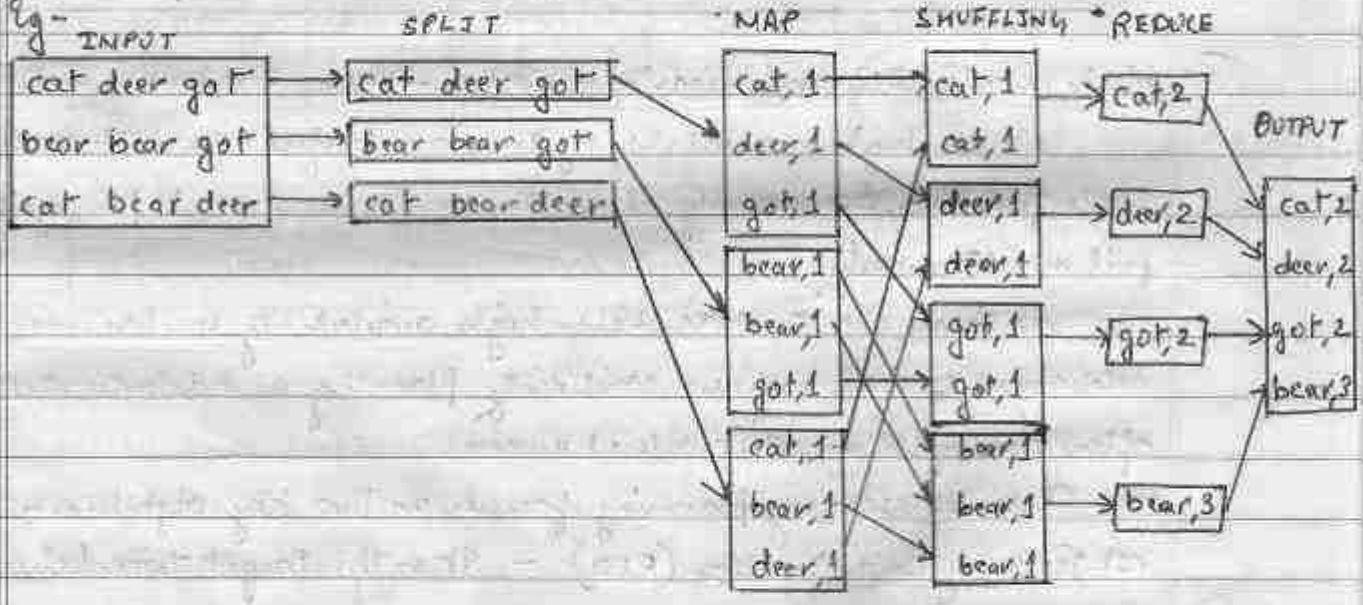
The framework is divided into two parts -

(1) Map - A function that parcels out work to different nodes in the distributed cluster.

(2) Reduce - Another function that collates the work and resolves the results into a single value

The MapReduce framework is fault-tolerant because each node in the cluster is expected to report back periodically with completed work and status updates. If a node remains silent for longer than the expected interval, a master node makes note and re-assigns the work to other nodes

A SIMPLE MAPREDUCE JOB



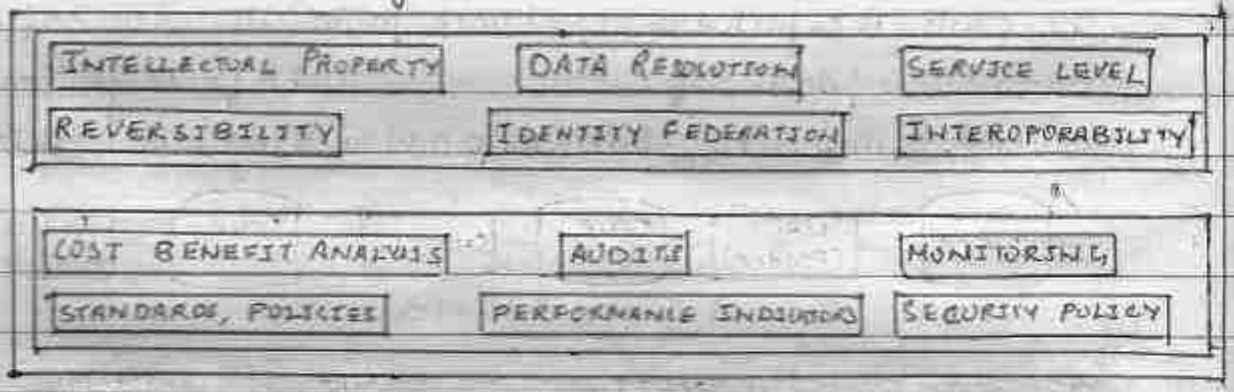
⑤ Cloud Governance -

It is the process of controlling the access to the service with the help of policies, tracking services using repositories, and logging and monitoring the execution of those services.

The main aim of cloud services governance is to protect data and applications which are located remotely.

It deals with -

(1) Setting company policy for cloud computing.
(2) Risk based decisions
(3) Assigning responsibilities for enforcing & monitoring of policy compliance
(4) Set corrective actions for non-compliance.
(5) Improve productivity.



⑥ High availability and disaster recovery -

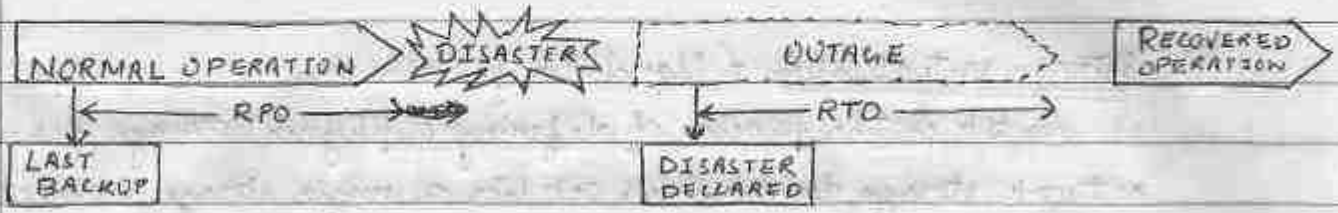
While high availability systems are designed to withstand any single failure. Occasionally disaster events cause multiple systems to fail simultaneously.

As these events overwhelm high availability mechanisms, an additional tier of business continuity planning and disaster recovery is often deployed to protect critical services.

Disaster recovery planning focuses on two key objectives -

(1) Recovery time Objective (RTO) - It is the target time between when disaster is declared and when service is restored on backup site.

(2) Recovery point Objective (RPO) - It is the most recent point in time to which system state can be restored onto backup site.



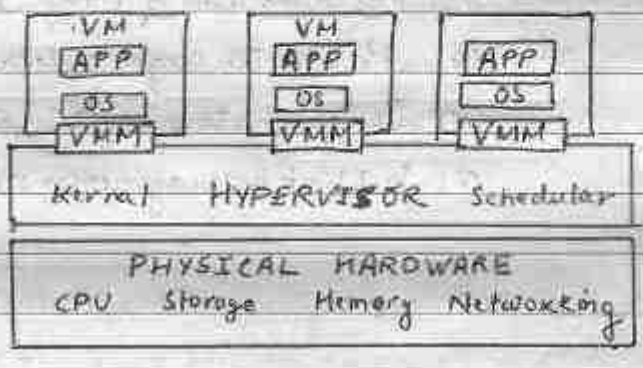
Although the RTO and RPO for critical failures are generally seconds or minutes while RTO and RPO for disaster events are often hours or days.

VIRTUALIZATION —

① Virtualization is defined as an abstraction of computer resources. It creates a virtual form of a device or any computer resource, like storage device, network, server and an operating system in which the framework partitions the resource into one or more execution environments.

② Compute Virtualization —

It is a technique for masking or abstracting the physical hardware from the operating system. It enables multiple operating system to run concurrently on single or clustered physical machines.



VMM → Virtual Machine Manager
VM → Virtual Machine
→ Virtualization layer resides between hardware and VM also called Hypervisor

→ Advantages —

(1) Run multiple OS concurrently
(2) Make OS and application, hardware independent
(3) Isolate VM from each other, no conflict
(4) Improves resource utilization
(5) Offers flexible infrastructure at low cost

③ Storage virtualization (Cloud Storage) -

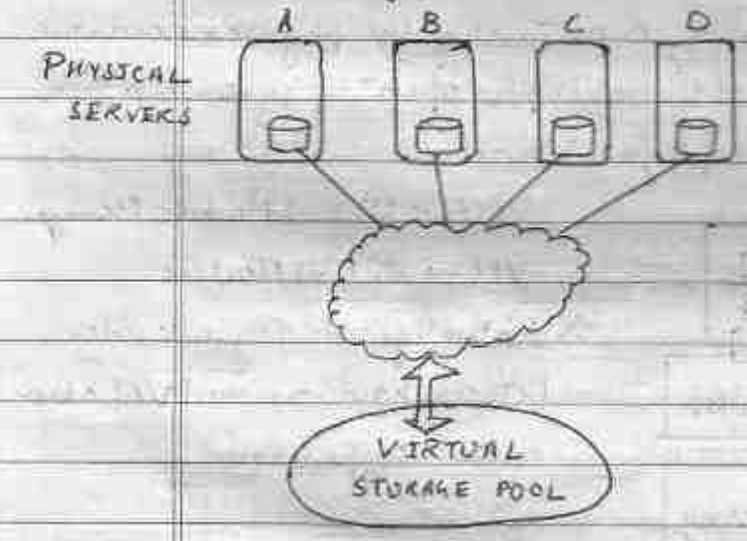
It is the process of defining a physical storage from several network storage devices which act like a single storage device. It allows the storage administrator to perform different tasks such as backup, recovery, archiving very easily, and that too in a short span of time.

Storage virtualization is structured in three ways -

(1) Network-based - In this, storage virtualization is treated as a network-based device

(2) Host-based - Physical drives are under the control of the traditional device driver in which a software layer existing above it intercepts I/O requests which finds metadata and redirects I/O.

(3) Storage device-based - The primary storage controller considers pooling and manages metadata which allows the direct attachment of any other storage controllers.



Advantages -

(1) Storage management is easy
(2) Less energy usage
(3) Reclamation of storage space is possible
(4) Ability to migrate data
(5) Increase storage utilization
(6) Support heterogeneous storage platform

Disadvantages -

(1) Does not allows vendors to easily interoperate very frequently
(2) Network system is highly complicated
(3) If a single server gets infected the whole network is compromised

④ Network Virtualization -

It is a process of logically segmenting or grouping physical network and making them operate as a single or multiple independent networks

called virtual networks.

Network virtualization involves virtualization of both physical and virtual machine networks.

Physical Network - It may consists of network adapters, switches, routers, bridge, repeaters, hubs. It provides connectivity -

(1) among physical servers running hypervisor.

(2) between physical sever and clients

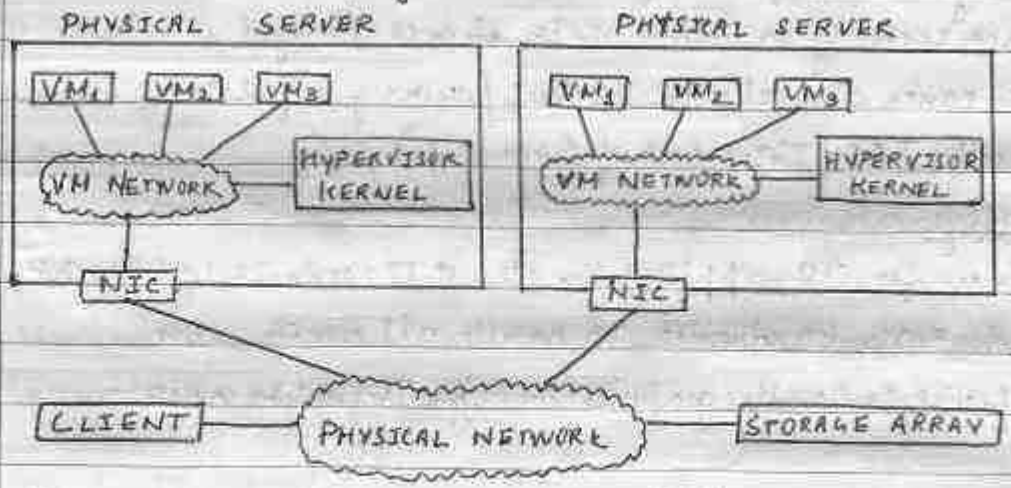
(3) between physical sever and storage.

Virtual Network - It resides inside a physical server. It includes logical switches. It provides connectivity -

(1) among VMs inside a physical server

(2) to hypervisor kernel

(3) connects to physical network.



Advantages -

(1) Enhance security

(2) Enhance performance

(3) Improves manageability

(4) Improve utilization

(5) Reduce capital expenditure

Disadvantages -

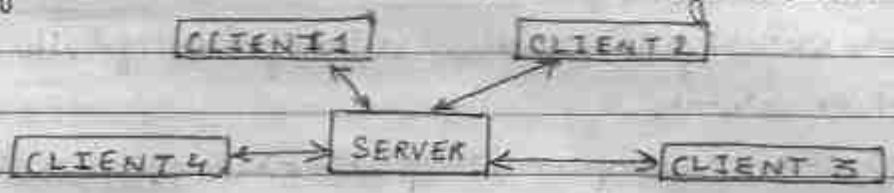
(1) Highly complex

(2) Requires thoughtful planning

(5) Desktop virtualization -

It provides a user with an operating environment that is separate from their local physical system. It consists of the server, virtualization

software on the screen and virtual image on the desktop.



There are two types of desktop virtualization -

(1) Server-hosted desktop virtualization - The operating environment will be hosted on a server manually located in a data centre and accessed by the end-users over the LAN or WAN.

(2) Client-hosted desktop virtualization - The operating environment runs locally on the user's system, hardware which includes hypervisor software which allows one desktop to run multiple ~~OS~~ OS's.

Advantages -

(1) Accessing desktop from anywhere
(2) Enhance security as administrator is centralized.
(3) Faster, easier and reliable backup/recovery of data.
(4) Reduced TCO (Total cost of Ownership).

Disadvantages -

(1) Licenses for OS, applications etc still needs to be bought.
(2) Needs extra bandwidth to handle all remote users.
(3) Difficult to handle graphics or High Definition video.

(6) Application Virtualization -

It is the technique of providing an application to an end user without any installations, integration or dependencies on the underlying computing platform.

APPLICATION	APPLICATION	APPLICATION
APPLICATION	SANDBOX	SANDBOX
APPLICATION	VIRTUALIZATION SOFTWARE	
OPERATING SYSTEM		
PHYSICAL OR VIRTUAL HARDWARE		

Two forms of application virtualization are -

(1) Remote application virtualization - Remote application are used to run on a server. It is possible for the end-users to view and interact with the required applications through a network via some remote display protocol.

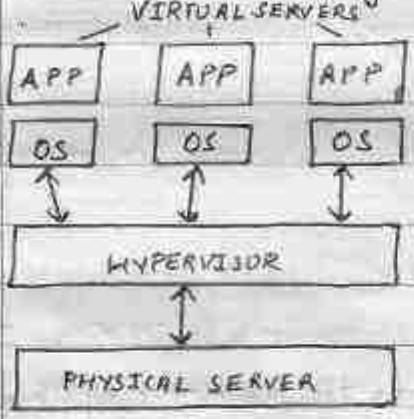
(2) Streaming application virtualization - Whenever an application is requested by the end-user, the components get downloaded to the local system based on the requirement. Once the downloading process is finished, the streamed application will work properly without any need of internet connection.

Advantages -
(1) No installation required
(2) Application retirement simplified
(3) No more application conflicts
(4) Simplifies OS integrations
(5) Multiple runtime environments

Disadvantages -
(1) Single point of failure
(2) Very high cost
(3) High bandwidth required

(7) Server Virtualization

It is the masking of server resources including the number and identity of individual physical servers, processors and operating systems from server ~~virtualization~~ users. The server administrator uses a software application to ~~de~~divide one physical server into multiple isolated virtual environments.



Server virtualization can be viewed as part of an overall virtualization trend in enterprise IT that includes storage virtualization, network virtualization and workload management.

There are three types of server virtualization -

(1) Para-Virtualization - It provides several OSs to run on a single set of hardware by making use of system resources very effectively.

Disadvantage - Requires the guest OS to be revised.

(2) Operating System virtualization - It involves a standard OS to run various applications which are controlled by different users on a single system at a time.

Disadvantage - Choice of OS is limited.

(3) Hardware Emulation - It is used when there is a need to run an unsupported OS within a VM. It is used to debug & verify a system which is under design.

Disadvantage - Need to install and update device drivers

→ Advantages of server virtualization -

(1) Reduce the number of servers.
(2) Reduces IT cost.
(3) More application can be run.
(4) Continuity in business
(5) Multiple OS on a single hardware platform.

Disadvantage -

(1) Slow
(2) limit the amount of storage space
(3) Performance degradation exists
(4) less secure

(8) Virtualization Benefits -

(1) Most mature, proven and comprehensive platform
(2) High application availability
(3) Wizard-based guides for ease of installation
(4) Simple and streamlined management
(5) High reliability and performance
(6) Superior security
(7) Greater savings
(8) Affordability.

(9) Block level storage virtualization -

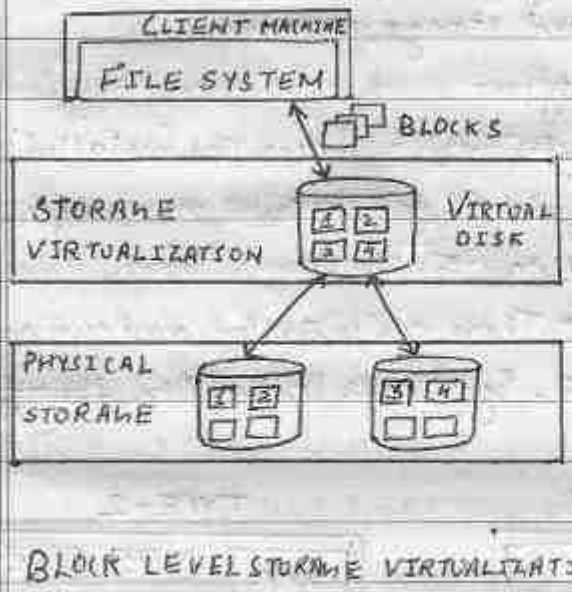
Storage capacity is made available to the OS or the applications in the form of virtual disks.

The task of the virtualization entity is to map these virtual blocks to the physical blocks of the real storage devices.

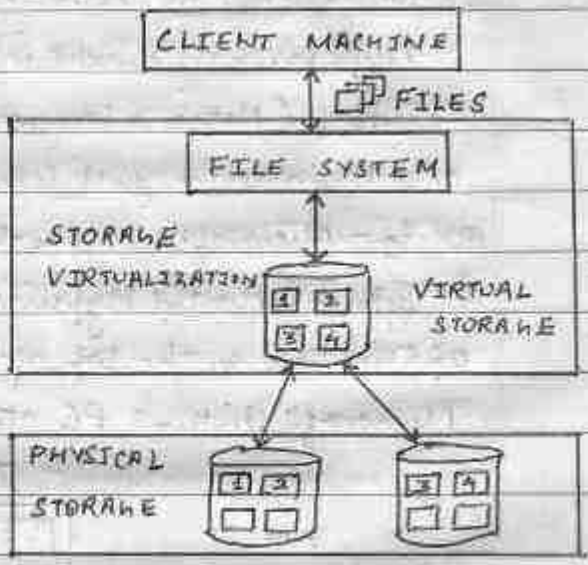
Date __/__/__
Page

File level storage virtualization -

The virtualization entity provides virtual storage to the OS or applications in the form of files and directories.



BLOCK LEVEL STORAGE VIRTUALIZATION



FILE LEVEL STORAGE VIRTUALIZATION

Advantages of block level storage virtualization -

(1) It is suitable if the storage is to be virtualized for as many as different OS and applications as possible.

(2) Actually necessary when dealing with applications that handle their storage access on block level and cannot work on file level.

Advantages of file level storage virtualization -

(1) Absolutely necessary for those who want to establish data sharing between several users

(2) File system management is done by the storage virtualization.

(10) Hypervisor management software -

Hypervisor is a computer virtualization software that enables multiple OS to run on a physical machine concurrently. It interacts directly with the physical resources of the compute system.

Hypervisor has two components -

(1) Kernel - provides the same functionality as other OS, like process creation, file system management, process scheduling, ~~resource~~ It also

provides resource scheduling, I/O stack etc.

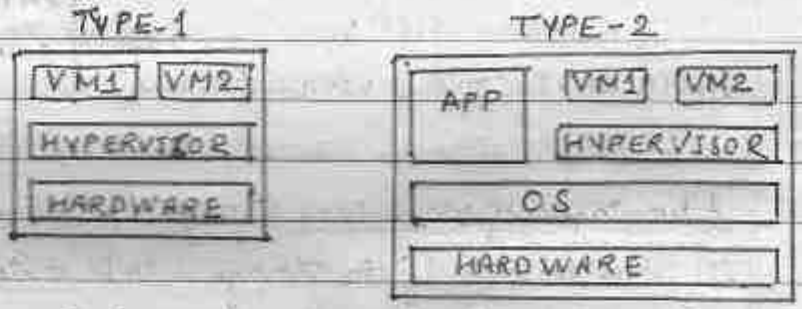
(2) VMM (Virtual Machine Manager) - It is a management solution for the virtualized datacenter, enabling you to configure and manage your virtualization host, networking and storage services.

Hypervisor are divided into two types -

(1) Type 1 (Native or bare-metal Hypervisor) - These are installed directly onto the hardware just like a regular OS gets installed on a single server.

Eg - Microsoft's Hyper-V, VMWare ESXi etc.

(2) Type 2 (Hosted Hypervisor) - These are installed and run as an application on the top of the OS. Eg - Oracle Virtual Box, ~~Microsoft~~ Microsoft Virtual PC etc.



(10) Hypervisor provides functions such as create VM, delete VM, move VM.

(11) Infrastructure Requirement -

Virtualization products have their requirements on backend infrastructure component including storage, backup, system management, security and time synchronization.

Ensuring that these components are of required configuration is critical for successful implementation.

Server virtualization suitability assessment -

One of the key advantages of virtualization is greater utilization of physical server resources. To ensure that existing servers will operate in a shared environment, detailed hardware inventory and performance utilization information must be obtained and analyzed for assessment purposes.

Detailed Design -

Virtualization introduces many changes into the environment and ensures that the platform can co-exist and interact with existing infrastructure.

The purpose of the detailed design is to set naming and security standards, define the disk and network structure. It includes the following -

(1) Security and Administrative model.
(2) Backup methodology.
(3) VMWare vsphere console configuration.
(4) Implement tables and configuration setting.

(12) Virtual LAN (VLAN) -

A virtual local area network (VLAN) is a network technology used to logically separate large broadcast domains using layer 2 devices.

VLAN standard is IEEE 802.1Q.

→ Types of VLAN are -

(1) Data VLAN - Main type of virtual network. It is designed to carry user-defined data.
(2) Default VLAN - This is the VLAN assigned by default to all ports. For CISCO switches this is VLAN 1.
(3) Native VLAN - This is the VLAN assigned to untagged packets, which have not yet travelled through a VLAN marked port.
(4) Management VLAN - A VLAN used for switch management.
(5) Voice VLAN - This is special type of VLAN used with VoIP devices.

→ Benefits of VLAN -

(1) Improved Security
(2) Higher Performance
(3) Cost Reduction
(4) Simplified network management.

(13) Virtual SAN (VSAN) -

A virtual storage area network (VSAN) is a logical partition in a SAN. It allows traffic to be isolated within specific portions of a SAN.

Benefits of VSAN -

(1) Virtual SAN Islands - A SAN island is a storage area network (SAN) that exists as a discrete, isolated entity within a larger SAN.

(2) Transparent to end devices

(3) ISL Trunking (Inter switch link) - Trunking allows ISLs to carry traffic for multiple VSANs on the same physical link.

(4) Fabric availability

(5) Fabric scalability

(6) Traffic management is easier

Fabric - The hardware that connects workstations and servers to storage devices in a SAN is referred to as a "fabric".