CLOUD COMPUTING

6TH SEMESTER

LECTURE NOTES

Prepared By:- MONALISA SWAIN

DEPARTMENT OF COMPUTER SCIENCE AND ENGINEEERING

SWAMI VIVEKANANDA SCHOOL OF ENGINEERING & TECHNOLOGY

MADANPUR, BHUBANESWAR, PIN-752054

Ch. 1

Introduction to cloud Computing

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Introduction :- Cloud computing is the delivery of computing services such as servers, storage, data bases, networking, s/w, analytics, intelligence & many more, over the cloud on a internet.

- The cloud environment provides an easily accessible online portal that makes handy for the user to manage the compute, storage, network & applicat° resources.

Historical development of cloud Computing :-

- In 1950, the main frame & time sharing are born introducing the concept of shared Comp. resources. During this time the word cloud was not in used.
- Cloud computing is believed to have been invented in the 1960's with his work on arpanet to connect people & data from any where at any time.
- In 1969 the 1st working prototype of arpanet is launched.
- In 1970 the word client server came into use. client server defines the computing model where clients access the data & applications from a central server.
- In 1995, pictures of cloud are started showing in diagrams at that time AT & T had already began to develop an architecture & system. Where data would be located centrally.
- In 1999 the sales for dot com was launched, the 1st company to make enterprise applicat° available from a website.
- In 1999 the search engine Google launches.

- In 1999 netflix was launched, introducing the new revenue way.
- In 2003 web 2.0 is born which is characterise by reach multimedia. Now the user can generate content.
- In 2004 facebook launches giving users facility to share themselves.
- In 2006 Amazon launched Amazon web services (AWS) giving the users a new way.
- In 2006 Google CEO Eric schmidt uses the word cloud as an industry event.
- In 2007 Apple launches iphone which could be used on any wireless net.
- In 2007 netflix launches streaming services & live vedio watching is born.
- In 2008 private cloud came into existance.
- In 2009 browser based application like Google apps are introduced in 2010 hybride cloud (private + public cloud) came in to existance.
- In 2012 Google launches Google drive with free cloud storage
- Now, that cloud adoption is present, this makes cloud computing more stronger.

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Vision of Cloud Computing :-

In simple terms, cloud computing means storing & accessing the data & programs on remote servers that are hosted on the internet instead of computer's hard drive or local server. cloud computing is also refer as internet based computing.

Following are the visions of cloud computing:-

- Cloud computing provide the facility to provision virtual hardware, runtime environment & services to a person having money. These all things can be used as long as they are needed by the user.
- The hole collect° of computing system is transformed into collect° of utilities, which can be provision & composed together to deploy systems in ours rather than deals with no maintenance cost.
- The long term vision of cc is that IT services are treated as utilities in an open market without technological & legal barriers.
- In the future we can imagin that it will be possible to find the solut° that matches with our requirements by simply entering our request in a global digital market that trades with cc services.
- The existance of such market will enable the automat° of discovery proces & its integrat° into its existing I/O systems.
- Due to existance of a global platform for trading cloud services will also help service provider to potentialy increase there revenew.
- A cloud provider can also become a consumer of a compilation service in order to fullfill its promises to customers.
- In the near future we can imagine a solut° that should our need by simply applying our applicat° to the

global digital market for cc services
- The presence of these market will enable the acquisit° process to automatically migrate with its existing s/w applications. The availability of global cloud trading platform will also help service providers to increase their revenues.

Characteristics of Cloud computing :-

- There are basically 5 essential characteristics of cloud computing.
  i) On demand self service
  ii) Broad Net. Access
  iii) Resource pooling
  iv) Rapid elasticity
  v) Measured service

i) On demand self service :-

The cc services does not require human administrators. users themselves are able to provision, monitor & manage computing resources as needed.

- Some of the service providers are - Amazon web services (AWS), microsoft, IBM, sells force.com.

ii) Broad Net. Acces :-

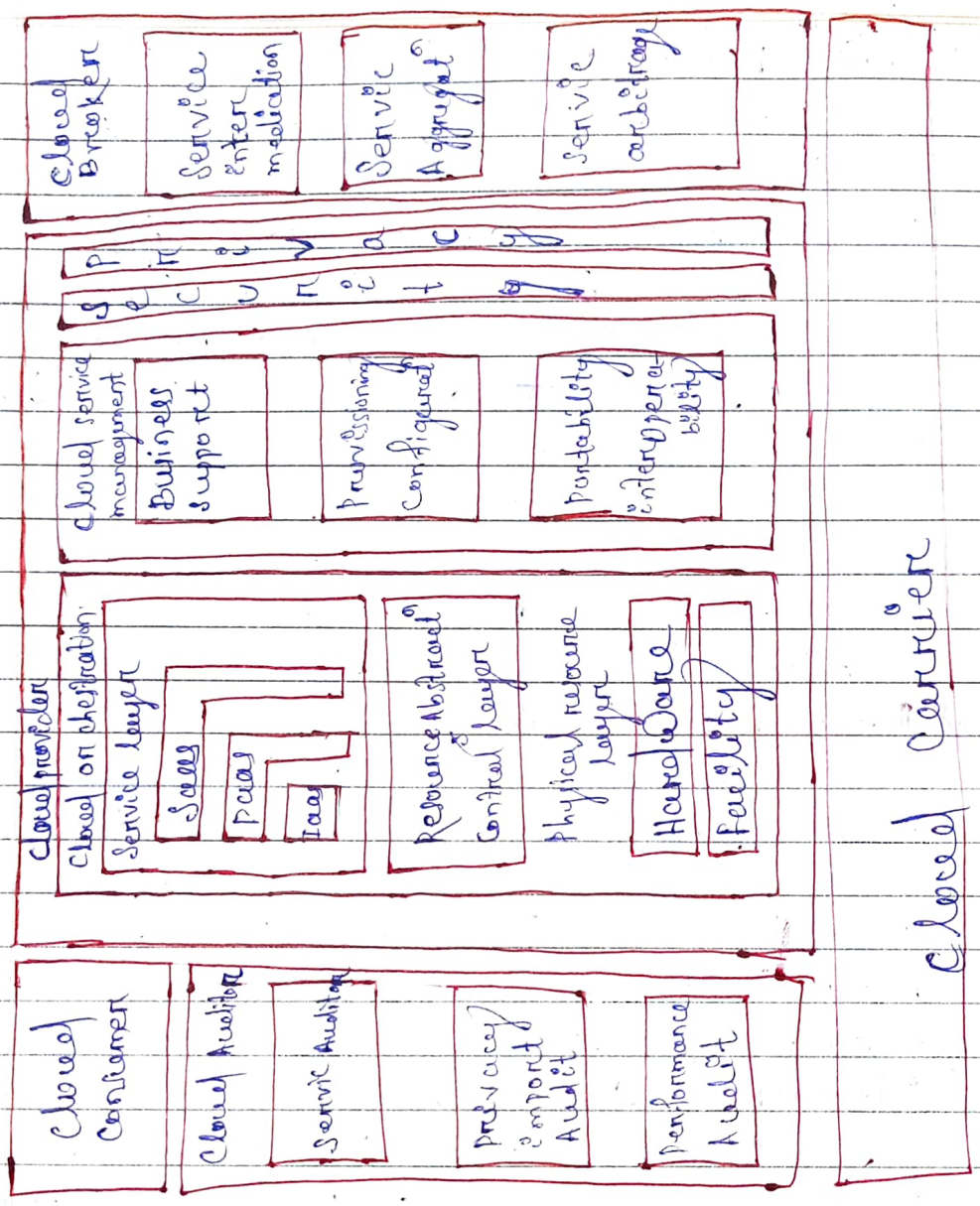
The computing services are generally provided over standard networks & heterogeneous devices. Cloud services are available over the net. & can be accessed through diff. clients such as Mobile, laptop, etc.

iii) Rapid Elasticity :-
On user demand cloud services can be made available & released. Cloud service capabilities are unlimited & used in any quantity at any time. The computing services should have IT resources that are able to scale out & in quickly & on a needed basis. Whenever the user requires service it is provided to him & it is scaled out as soon as its requirement gets over.

iv) Resource pooling :-
Same resources can be used by more than 1 customer at the same time. For e.g. storage, network bandwidth can be used by any no. of customers without knowing the exact location of that resources.

v) Measured Service :-
resources used by the user, can be monitored and controlled. There report is available for both cloud providers & consumers. On the basis of this measured reports cloud systems auto-matically control & optimize the resource based on the type of services. Services can be like storage, processing, bandwidth, etc.

Cloud computing reference Model :-



- The National Institute of Standards & Technology (NIST) definat of cloud computing is widly accepted to world providing a clear understanding of cloud technology & services.
- The architecture defines 5 major actors - cloud consumer, cloud provider, cloud carrier, cloud auditor & cloud broker.
- Each actor is an entity (a person or a

organizat°) that participates in a transact° or process $ or performs tasks in cloud computing.

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Cloud computing Environment :-
The environment of cc basically consists of
a) Applicat° development.
b) Infrastr. & system development
c) Computing platforms & technologies.

a) Application Development :-
- Applicat° that leverage cloud computing have applicat° are one class of way.
- Applicat's performance influenced by workload generated by the diff. user demand with the diffusion of web 2.0 technologies, the web has become a platform for developing rich & complex applicat°s.
- It includes enterprise applicat° that now leverage the internet as the preferred channel for service delivery & user interact°.
- Resource intensive applicat°s are another class of it. These can be either data intensive & compute intensive comp. applicat°. For e.g. scientific applicat°s.
- Resource intensive applicat°s are not interactive & they are mostly characterised by batch processing.
- CC provide applicat° services that mimics behaviours of desktop applicat° but that are completely hosted & managed on the provider site.
- Developer access such services via simple def

Web interfaces, often implemented through Representational State Transfer Web services.

b) Infrastructure & system development :-
- IaaS, PaaS, SaaS provides the capabilities to add & remove resources.
- PaaS solut^{n}s embed into into there core offering algorithms & rules that control the provisioning process & the lease of resources.
- Integrat^{n} bet^{n} cloud resources & existing system ~~cloud~~ deployement is another element of concern.
- Web 2.0 technologies constitute the interface through which CC services are delivered managed & provision.
- Virtualizat^{n} technology is a core feature of the infrastr. used by the cloud providers.

c) Computing platform & Technologies :-
- Development of a CC applicat^{n} happens by leveraging platforms & frameworks that provide diff. types of services, from bare metal infrastr. to customizable applicat^{n}s serving specific purposes.

Some of the CC platforms & technologies are
- Amazon Web services provides customers with wide array of cloud services.
- Google app engine → for developing & hosting web applicat^{n} in Google managed data centers.
- Microsoft azure → It provides a range of cloud services, including those for

compute analytics, storages & networks.
- Hadoop → is the Java based framework used to manipulate data in the cloud or on premises. Hadoop can be integrated in cloud services to manage big data. Where as cloud alone can not manage data without hadoop int.
- Cellphones.com → It is a cloud computing SaaS that specializes in customer relationship management cellphones services allow businesses to use cloud technologies to better connected with customer, partner & potential customer.
- Manjrasoftaneka → It is focuses on the creation of innovative s/w technologies for simplifying & developing & deploying of application on private or public clouds.

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- Cloud Service Requirements :-
The basic requirements of a cloud service are.

a) Efficiency / cost Reduction :-
By using cloud internet you don't have to spend less amount of money on purchasing & maintaining equipment.

b) Data Security :-
Cloud offers many advanced security features that guarantee that data is securely stored & handled. Cloud storage providers implement base line protocols for there platform & the data they process such as authentication, access control & encryption.

c) Scalability :-
Diff. companies are diff. IT needs. A large enterprise of 1000+ employees.

Dev/prod have the same IT requirements as a starts on using cloud is a great solut° because it enables enterprises to efficiently & quickly scale up or down according to business demands.

d) Mobility :-

Cloud Computing allows mobile access to corporate data via smart phone & devices which is a great way to ensure that no one is ever left out of the loop. Staff with business schedules or who leave a long way away from the corporate office, can use these features to keep instantly up to data with client & co-workers.

e) Disaster Recovery :-

Data loss is a measure concern for all organizat°, along with data security. Storing your data in the cloud guarantees that data is always available, even if your equipments like laptops or pcs is damaged. Cloud based services provide a quick data recovery for all kinds of emergency sencenarios.

f) Control :-

Cloud enables you complete visibility & control over your data. You can easily decide which users have what kind of access to which data.

g) Market reach :-

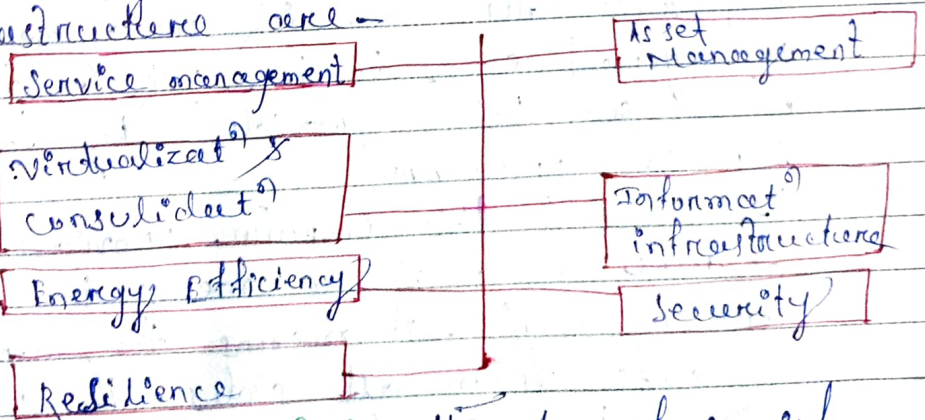
Developing in the cloud enables users to get their applicat° to market

quickly.

h. Automatic s/w updates :
Cloud based applicat^{n} automatically refresh & update themselves.

Cloud & Dynamic infrastructure :

- Dynamic cloud is the ability form s/w & services to grow with your business.
- Dynamic cloud allows business to quickly develope through composing new applications using free build components.
- Flexbility, adaptability, scalebility - these are the capabilities that dynamic cloud brings to beam.
- Dynamic clouds enable these by providing policy regain monitoring that fix analysis that in turn exicutes act^{n} to add & remove compute, networking or even storage resources as needed to maximize performance while minimizing costs.
- Some key features of dynamic cloud infrastructure are -



i) Servile Management :- This type of special facilities or functionality is provided to the cloud IT services by the cloud service providers. This facility includes visibility

automation and control to delivering the first class IT services.

ii) Asset :- Management in this the assets or the property which is involved in providing the cloud services are getting managed.

iii) Virtualizat^{n} & Consolidat^{n} :-

Consolidat^{n} is an effort to reduce the cost of a technology by improving its operating efficiency and effectiveness.

- It means managing from large no. of resources to fewer one. Which is done by virtualizat^{n} technology.

iv) Informat^{n} infrastructure :-

It helps the busines organizat^{n} to achieve the following : Informat^{n} compliance, availability of resources retention and security objectives.

v. Energy Efficiency :-

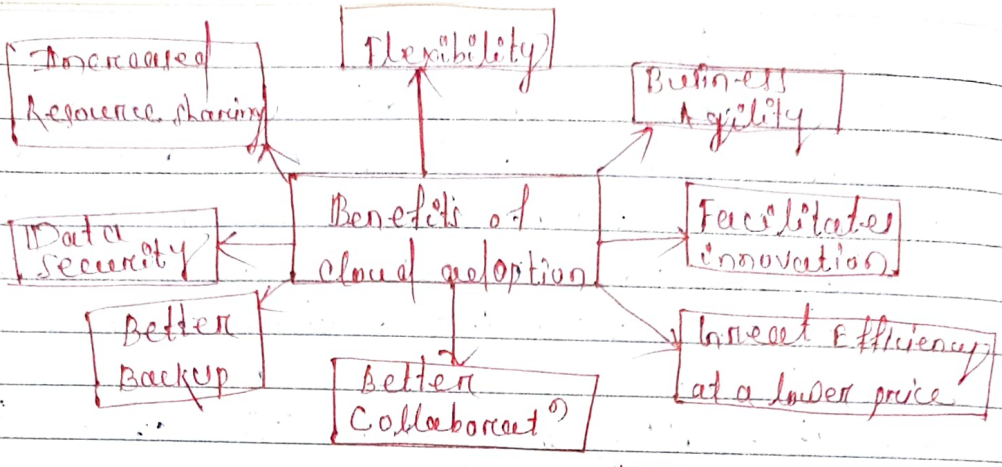
Here the IT infrastructure an organizat^{n} suitable. It means it is not likely to damage or effect any other thing.

vi. Security :- This cloud infrastructure is responsible for the risk management. Risk management refers to the risks in the services which are being provided by the cloud service providers.

vii) Resilience :- This infrastr. provides the features of resilience means the services are resilient. It means the infrastructure is safe from all sides. The IT operat's will not be easily get affected.

Cloud Adoption :

- Cloud adopt° means adopting a service or technology from another cloud service provider.
- Here cloud means the environment of cloud where the cloud services are being operated.
- Adopt° term states that accepting the services of new technology.
- Adopt means following some kind of new trend or existing trend or a technology.
- This cloud adopt° is suitable for low priority business applicat°s.
- It supports some interactive applications that combines two or more data sources.
- For e.g. if a marketing company requires to grow his business in the whole country in a short span of time then it must need a quick promotion or short promotion across the country.
- Cloud adoption is useful when the recovery management, backup recovery based implementat°s are required. By considering the above key points we concludeble that it is only suitable for the applicat°s that are modelen and loosely coupled.
- It will work well with research and development projects.
- It means the testing of new services, design models and also the applications that can be get adjusted on small servers.
- Applicat°s which requires diff. level of increasin throughout the day or throughout the month should be deployed. Through the cloud.
- The applicat° whose demand is unknown can also be deployed using cloud.



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Cloud Applications :

- Cloud service providers provide various applications in the field of art, business, data storage and backup services, education, entertainment, management, social networking, etc.
- The most widely used cloud computing applications are given below -

a) Art Applications :-

Cloud computing offers various art applications for quickly and easily design attractive cards, booklets, and images. Some most commonly used cloud art applications are given below :

i) Moo : Moo is one of the best cloud art applications. It is used for designing and printing business cards, postcards, and mini cards.

ii) Vistaprint :-

Vistaprint allows us to easily design various printed marketing products such as business cards, postcards, Booklets, and labeling, Invitations cards.

iii) Adobe Creative cloud :-

Adobe Creative cloud is made for

designers, artists, filmmakers, and other creative professionals. It is a suite of apps which includes photoshop image editing programming, illustrator, In design, Typekit, Dreamweaver, XD, and audition.

b. Business Applications :

Business applicat^{n} are based on cloud service providers. Today, every organizat^{n} requires the cloud business applicat^{n} to grow their business. It also ensures that business applicat^{n}s are 24x7 available to users.

- There are the following business applicat^{n}s of cloud computing :

i) Mailchimp :- Mailchimp is an email publishing platform which provides various ~~opt~~ options to design, send, and save templates for emails.

ii) Salesforce :-

Salesforce platform provides tools for sales, service, marketing, e-commerce, and more. It also provides a cloud development platform.

iii) Chatter :-

Chatter helps us to share important informat^{n} about the organizat^{n} in real time.

iv) Bitrix 24 :-

Bitrix 24 is a collaborat^{n} platform which provides communicat^{n}, management, and social collaborat^{n} tools.

v) Paypal :-

paypal offers the simplest and easiest online payment mode using a secure internet account. paypal accepts the payment through debit cards, credit cards and also from paypal account holders.

vii) Slack : Slack stands for Searchable Log of all conversation and knowledge. It provides a user-friendly interface that helps us to create public and private channels for communication.

viii) Quickbooks :-

Quickbooks works on the terminology "Run Enterprise anytime, anywhere, on any device." It provides online accounting solution for the business. It allows more than 20 users to work simultaneously on the same system.

3. Data Storage & Backup Applications :

Cloud computing allows us to store information (data, files, images, audios, and videos) on the cloud and access this information using an internet connection. As the cloud provider is responsible for providing security, so they offer various backup recovery application for retrieving the lost data.

- A list of data storage & backup applications in the cloud are given below-

i) Box.com :-

Box provides an online environment for secure content management, workflow, and collaboration. It allows us to store different files such as Excel, Word, PDF, and images on the cloud. The main advantages of using box is that it provides drag & drop service for files and easily integrates with office 365, G suite, Salesforce, and more than 1400 tools.

ii) Mozy :- Mozy provides powerful online backup solutions for our personal and business data. It schedules automatically backup for each day at a specific time.

iii) Joukuu :-

Joukuu provides the simplest way to share & track cloud-based backup files. Many users use joukuu to search files, folders, and collaborate on documents.

iv). Google G-suite :

Google G suite is one of the best cloud storage and backup applicat°. It includes Google Calender, Docs, Forms, Google+, Hangouts, as well as cloud storage & tools for managing cloud apps. The most populer app in the Google G suite is Gmail. Gmail offers free email services to users.

4. Education Applications :-

- cloud computing in the educat° sector becomes very popular.
- It offers various online distance learning platforms & student informat° portals to the students.
- The advantages of using cloud in the field of education is that it offers strong virtual classroom environments, Ease of accessibility, secure data storage, scalability, greater reach for the students and minimal h/w requirements for the applicat°s.
- There are the following educat° applicat°s offered by the cloud :

i) Google Apps for Education :-
Google apps for educat° is the most widely used platform for free web-based email, calendar, documents and collaborative study.

ii) Chromebooks for Educat° :-
Chromebook for Educat° is one of the most imp. Google's projects. It is designed for the purpose that it

iii) Tablets with Google play for Educat° :-
It allows educators to quickly imp. the latest technology solut° into the classroom and make it available to their students.

iv) AWS in Education :-
AWS cloud provides an educat°-friendly environment to universities, community colleges & schools.

5. Entertainment Applications :-
- Entertainment industries use a multi-cloud strategy to interact with the target audience.
- Cloud computing offers various entertainment applicat° such as online games and video conferencing.

i) Online games :- Today, cloud gaming becomes becomes one of the most imp. entertainment media.
- It offers various online games that run remotely from the cloud.
- The best cloud gaming services are Shadow, GeForce Now, Vortex, project xcloud

and playstation Now.

ii) Video Conferencing Apps :-

Video conferencing apps provides a simple and instant connected experience. It allows us to communicate with our business partners, friends, and relatives using a cloud-based video conferencing.

- The benefits of using video conferencing are that it reduces cost, increases efficiency, and removes interoperability.

6. Management Applications :-

Cloud computing offers various cloud management tools which help admins to manage all types of cloud activities, such as resource deployment, data integrity, & disaster recovery.

- These management tools also ~~provide~~ provide administrative control over the platforms, applications, and infrastructures.
- Some imp. management applications are :-

i. Toggl :- Toggl helps users to track allocated time period for a particular project.

ii. Evernote :-

Evernote allows you to sync and save your recorded notes, typed notes, and other notes in the convenient place. It is available for both free as well as a paid version.

- It use platforms like Windows, Mac OS, Android, iOS, Browser, and unix.

iii) Outright :-

Outright is used by management users.

7. Social Applications :-

Social cloud applicat^{n}s allow a large no. of users to connect with each other using social networking applications such as Facebook, Twitter, LinkedIn, etc.

- There are the following cloud based social applicat^{n}s -

i) Facebook :-

Facebook is a social networking website which allows active users to share files, photos, videos, status, more to their friends, relatives, and business partners using the cloud storage system. On Facebook, we will always get notificat^{n}s when our friends like and comment on the posts.

ii) Twitter :-

Twitter is a social networking site. It is a microblogging system. It allows users to follow high profile celebrities, friends, relatives, and receive news.

- It sends and received short posts called tweets.

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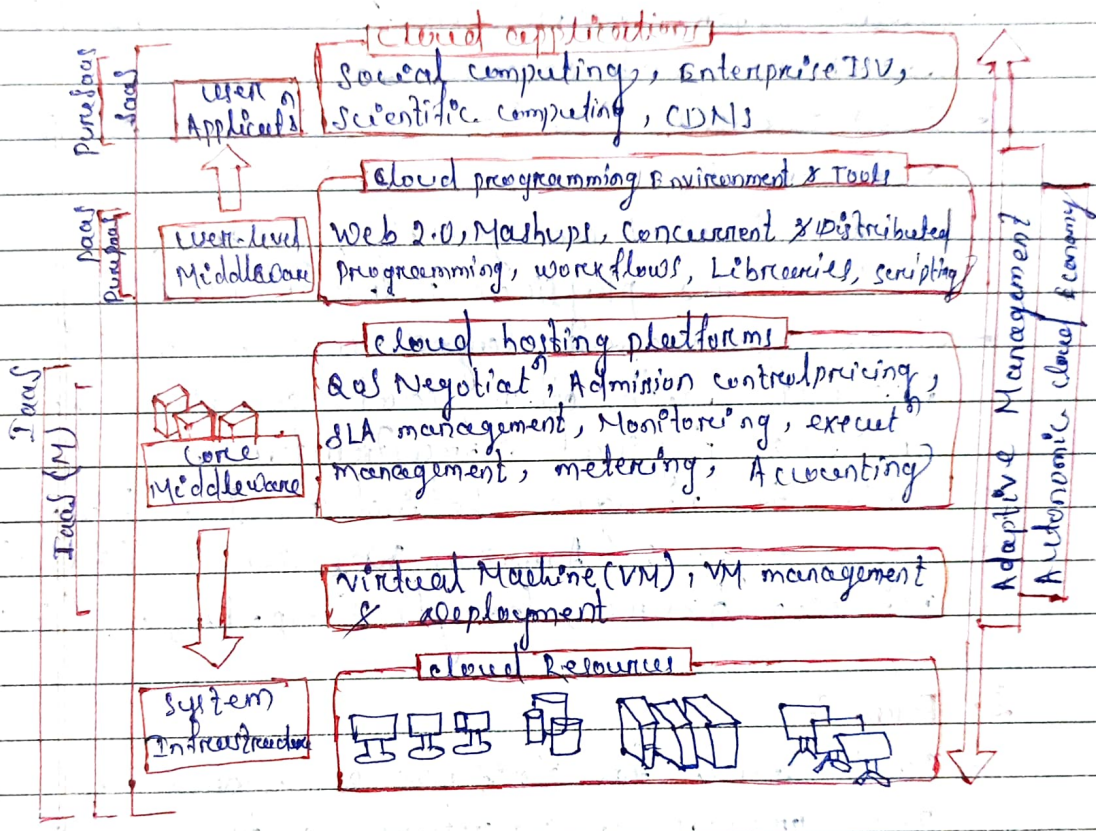
Cloud Computing Architecture

Cloud computing is a utility-oriented & internet centric way of delivering IT services on demand. As seen in the image below:

- Cloud computing architecture includes:
  1. IaaS : infrastr. as a service
  2. PaaS : platform as a service
  3. SaaS : S/W as a Service



~~Cloud infrastr. can be hetero~~

Cloud Infrastructure :-

Cloud infrastr. can be heterogeneous in nature because a variety of resources, such as :

- clusters (Smallest unit of net. is cluster)
- Networked PCs
- Databases
- Cloud application
- Cloud programming tools

- Hosting platforms
- Virtual Machines, etc. are used.

From the dig. above, We will discuss about:

1. Iaas :-
- Iaas stands for infrastr. as a service.
- Infrastr. as service as Iaas is the basic layer in cloud computing model.
- Iaas offers servers, net. devices, load balancers, database, web servers etc.
- Iaas examples can be categorized in 2 categories
  a. Iaas Management layer
  b. Iaas physical infrastructure
- Some management layer also required integrate with other Iaas solutions that provide physical infrastructure.
- Main technologies behind Iaas is h/w virtualization
- Some e.g.s : Amazon Web Services (AWS), Microsoft Azure, Google Comp. Engine (GCE).

2. Paas :-
- paas stands for platform as a service.
- paas provide a computing platform with a programming language execut environment.
- paas offered to the user is a development platform
- paas solut generally include the infrastr. as well.
- pure paas offered only the user level middleware
- Some e.g : Google App Engine, force.com

3. Saas :-
- Saas stands for S/W as a service
- S/W as a service (Saas) allows users to connect to and use cloud based apps

over the internet.
- SaaS is the service with which end users interact directly.
- Some e.g: Gmail, Google drive, Dropbox, Whatsapp

4. User applications:
- It includes cloud applications through which end user get interact.
- There may be diff. types of user applicat's, like scientific, gaming, social etc.
- Some of the eg.s are Gmail, facebook.com, etc.

5. User level Middleware:
- It includes cloud programming environment & tools.
- There may be diff. types of programming environments and tools depends on the user applicat's.
- Some of the e.g.s of user level middleware are web 2.0, libraries, scripting.

6. Core Middleware:
- It includes cloud hosting platforms.
- It manage quality of service.
- Execut° management.
- Accounting, metering etc.
- Virtical machines are the part of core middleware

7. System infrastructure:
- It includes cloud resources.
- Storage, hardware
- Servers, databases are part of it.

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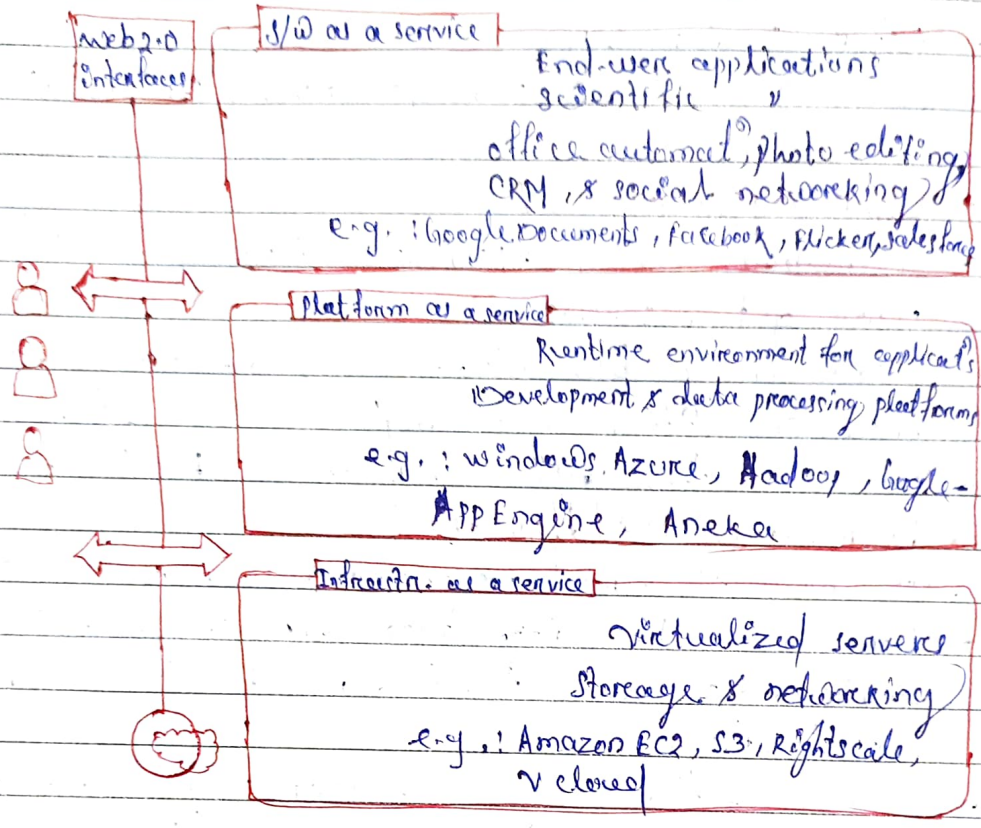
Cloud Computing reference Model:

The reference model for cc is an abstract model that characterizes & standardizes a cc environment by partitioning it in to

abstraction layers & cross-layer functions.



- As per the reference model, the cloud computing services can classified into:
  a) Infrastructure as a Service (IaaS)
  b) Platform as a Service (PaaS)
  c) Software as a Service (SaaS)
  d) Web 2.0

a) Infrastructure as a Service (IaaS):-

IaaS ~~as a service~~ is a cloud computing offering in which a vendor provides users access to computing resources such as servers, storage & networking.

b) Platform as a Service (PaaS):-

PaaS is a cloud computing offering

that provides users with a cloud environment in which they can develop, manage & deliver applicat°s.

c) Software as a service (SaaS) :-

SaaS is a cloud computing offering that provides users with access to a vendor's cloud-based S/W. users do not install applicat°s on their local devices. Instead, the applicat°s reside on a remote cloud net. accessed through the web or an API. Through the applicat°, users can store and analyze data & collaborate on projects.

d. Web 2.0 :-

Web 2.0 is the term used to describe a variety of web sites and applicat°s that allow anyone to create & share online information or material they have created. A key element of the technology is that it allows people to create, share, collaborate & communicate.

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Short notes

1. IaaS :-

- IaaS stands for infrastr. as a service.
- IaaS is the basic layer in cloud computing model.
- IaaS offers servers, network devices, load balancers, database, webservers, etc.
- IaaS e.g.s can be categorised in 2 categories:
  a. IaaS management layer
  b. IaaS physical infrastructure

- Some service providers provide both of above categories & some provide only management layer.
- IaaS management layer also required integrat with other IaaS solut that provide physical infrastructure.
- Main technology behind IaaS is the h/w vertualizat
- Some e.g.s are : Amazon web services (AWS), Microsoft Azure, Google Compute Engine (GCE)

2. PaaS :

- PaaS stands for platform as a service.
- PaaS provides a computing platform with a programming language execution environment.
- PaaS provides a development & deployement platform for running applicat in the cloud.
- PaaS constitutes the middle ware on top of which applicat's are build.
- Applicat management is the core functionality of the middle ware.
- For users paas interfaces can be in the form of a web baste interface, or in the form of programing APIs (Applicat programming interface) & libraries.
- PaaS solut's generally include the infrastr. as well.
- Some e.g.s are : Google app engine, force.com

Characteristics of PaaS :

The characteristics of PaaS are :

a) Runtime framework :-

The runtime framework exicutes end-user code according to the ~~policy~~ policies set by

the user & the provider.

b. Abstraction :- Paas offers a way to deploy & manage applicat's on the cloud rather than a virtual machine on top of which the IT infrastr. is build & configured.

c. Automation :- Paas deployes the applicat's automatic

d. Cloud services :- These provide services for creat°, delivery, monitory, management reporting of applicat's.

3. Saas :

- Saas stands for s/w as a service.
- Saas allows users to connect to & use cloud based apps over the internet.
- It provides a means to free users from complex h/w & s/w management.
- They simply access the applicat° website, enter their prediction & billing details & can instantly use the application.
- Applicat° is available to customer on demand.
- Customers can customize the s/w as per there choice.
- Some e.g.s are : Gmail, Google drive, dropbox, whatsup.

Characteristics of Saas :-

- The product sold the custome is applicat° accessed.
- The applicat° is centraly managed.
- The service delivered is one-to-many.
- The service delivered is an integrated & client° delivered on the contract, which means provided as promised.

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Types of cloud :

Cloud constitute the primary outcome of cloud computing. Cloud build the infrastructure on top of which services are implemented & delivered to the customers. According to the administrative domain clouds are classified.

Cloud type identifies the boundaries within which CC services are implemented.

- There are 4 diff. types of clouds:
  a) public cloud
  b) private cloud
  c) Hybrid or heterogeneous cloud
  d) Community cloud

a) Public Cloud :-

- The cloud is opened to the wider public.
- In public cloud the services offered are made available to any one from anywhere & at any time through the internet.
- From a structural point of view they are a distributed system.
- In public clouds one or more data centers are connected together on the data centers services are implemented.
- Customer may require his/her credentials or billing details to access the offered services.
- Small enterprizes prefer public cloud due to its less cost.
- public clouds offer renting the infrastructure or subscribing to applicant services.
- Public clouds offer any kind of services like IaaS by Amazon EC2 is a public cloud.

SaaS by Salesforce.com is a public cloud. At the same time, large quantity of user can access the public cloud.

b. Private cloud :-
- The private cloud is implimented with in the private premises of an institute & generally made accessible to the members of the institute or a subset of them.
- When customers privacy is important, private clouds are preferable over public clouds.
- Instead of pay-as-you-go model as in public cloud, there could be other scheme in private clouds.
- In private cloud, sensitive information are kept in house.
- private cloud provides customer information protect better than public clouds.
- private clouds can be implimented on more heterogeneous (diff) h/w.
- Some of the options available for private deployement of clouds we can consider are: data synapse, Zimory pools, Elastra & Aneka.

C. Hybrid cloud :
- Hybrid clouds are the combination of private & public clouds.
- private clouds stands alone are sometimes not scalable. So here advantages of public cloud are taken.
- public clouds suffer with security threats & administrated risk fails. So advantages of private clouds are taken.

- When advantages of public clouds & private clouds are taken together, it is known as hybrid cloud.
- Hybrid clouds allow the services to be taken from public clouds when needed & keep the sensitive informations with in private clouds.
- Hybrid clouds use cloud bursting, in which services are taken when required & realized when not in use.
- Dynamic provisioning refers to the ability to acquire on demand virtual machines in order to increase the capability of the resulting distributed system & then release them.

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d. Community Cloud :-

- Community cloud are distributed systems created by integrating the services of diff. clouds to address the specific needs of an industry, a community or a business sector.
- Sectors for community cloud are as follow: Media industry, Health care industry, Energy & other core industries, public sector, scientific research, etc.
- Community can provide a shared environment where services can ~~classified~~ facilited business-to-business collaboration.

Benifits of community clouds are:

i) Openness :- By removing the dependency on cloud vendors, community clouds are open system in which fair competit

Standards :

- Several standards organizations have been working hard to clarify, define & qualify the functions of cloud interoperability & portability. The goal is a more open cloud computing environment that minimizes the risk of vendor barriers ~~the risk of~~ & avoids the inefficiencies of incompatible services.
- As long ago as 2013, the open Group produced a "cloud computing portability & interoperability guide.
- In 2016, the European Telecommunications Standard Institute (ETSI) published a special report called "Cloud standards co-ordination phase 2; interoperability & security in cloud computing".
- August 2017, the National Institute of Standards & Technology (NIST) & the Institute of Electrical & Electronic Engineers (IEEE) announced a joint collaborative effort to meet the growing demand for standards that address "intercloud" interoperability.
- The International Organization for Standardization (ISO) recently published ISO/IEC 19941:2017 (Information technology - Cloud computing - Interoperability & portability), which offers a consensus understanding of interoperability & portability & establishes a terminology & conceptual framework.

19/04/22

Cloud Computing interoperability use cases :

use cases in the context of cloud computing refers to typical ways in which cloud customers & providers interact. NIST, OMG, DMTF & others as part of there efforts related to standards for data portability, cloud interoperability, security & management have developed use cases for cloud computing.

NIST defined 21 use cases classified into 3 groups : cloud management, cloud interoperability & cloud security [BADZAR 2010].

These use cases are listed below :

1. Cloud Management use cases :
   - Open an account.
   - Close an account.
   - Terminate an account.
   - Copy data object in to cloud.
   - Copy data object out of a cloud.
   - Erase data objects on a cloud.
   - virtual machine control : allocate VM instance.
   - VM control : Manage VM instants state.
   - Query cloud provider capabilities & capacities.

2. Cloud interoperability use cases :
   - Copy data objects between cloud providers.
   - Dynamic operation dispatch to Iaas cloud.
   - Cloud burst from data center to cloud.
   - Migrate a queuing based application.
   - Migrate virtual machines from one cloud provider to another.

- E-discovery
- Security Monitoring
- sharing of access to data in a cloud.

OMG presents a more abstract set of use cases as a part of the open cloud manifesto. These are much more generic than those published by NIST & relate more to deployement than to your says. The list of use cases are :

- End user to cloud : Application running in the public cloud & accessed by end users.
- Enterprise to cloud to end user : Application running in the public cloud & accessed by end users.
- Enterprise to cloud : ~~to end~~ Application running in the public cloud integrated with internal IT capabilities.
- Enterprise to cloud to enterprise : Application running in the public cloud & inter operating partner applications.
- private cloud : A cloud hosted by an organization firewall.
- Changing cloud vendors : An organization using cloud services decides to switch cloud providers or work with additional providers.
- Hybrid cloud : Multiple clouds work together, co-ordinate by a cloud broker that Federate data, applications, user identity, security & other details.

DMTF produced a list of 15 use cases specifically related to cloud management

- Establish relationship.
- Administer relationship.
- Establish service contract
- Update service contract
- Contract reporting
- Contract billing
- Terminet service contract
- provession resources
- Deploy service templet
- Change resource capacity
- Monitor service resource
- Create service templet
- Create service offering
- Notification of service condition or event.

Access the complete set of use cases proposed by NIST, OMG & DMTF. 4 types of use cases concern enterprise-provider interaction that cloud benifit from the existance of the standards. These interaction relate to interoperability & can be maped to the following 4 basic cloud interoperability use cases.

a) Workload Migration
b) Data Migration
c) User authentication
d) Workload Management.

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a) Workload Migration :-

A workload that exicutes in one cloud provider can be uploaded to

another cloud provider. Some standardizat° efforts that support these use case are Amazon Machine Image (AMI), open virtualization frame (OVF) & vertual Hard Disk (VHD)

b) Data Migration :-

Data that resides in one cloud provider can be moved to another cloud provider. A standardizat° effort that supports this use case is Cloud Data Management Interface (CDMI). In addition, even though SHOP & REST are not data specific standards, multiple Cloud Storage providers support data & storage management interfaces that use SHOP & REST.

c) User Authentication :-

A user who has established an identity with a cloud provider can use the same identity with another cloud provider. Standardizat° efforts that support this use case are Amazon Web Service Identity Access Management (AWS IAM), OAuth with open Id, WS security.

d) Workload Management :-

Certain tools developed for cloud workload management can be used to manage multiple cloud resources from different vendors. Even though most environments provide a form of management console or command line tools, they also provide APIs based on REST or SHOP.

Role of standards in cloud computing environment :-

Cloud users good particularly welcome standards that address the workload migration & data migration use cases because such standards good mitigate vendors lock in concerns. This requires standardization of virtual machine image file formats & APIs for cloud storage. However, cloud providers use different types of service models & some service models stand to benifit more from standardization than other.

IaaS :

IaaS is the service model that good most benifit from standardization because the main building block of IaaS are workloads represented as virtual machine image & storage units that vary from file data to raw data for workload migration standardization efforts such as ovf & VHD good allow users to extract an image from one provider & upload it to another provider. Given that most IaaS providers allow consumers to install & run any operating systems. A more manual & time consuming form of migration good be to retrive the image from the current provider, create a new image on a new provider & reinstall the software. This manual migration would not required standard as long as there is

a way to retrive the application itself.

Paas :-

The Paas service model benifit less from standardization than Iaas. Organization that buy or do paas also get for the advantages of the development platform. The platform provide many capabilities out of the box such as Manage Application Environment, user authentication data storage & other functionality in the form of libraries that can be integrated in to application. This functionality is tied to a specific language & even time environment. For e.g. Google app engine supports application written in Java, python & Go. Microsoft azure supports applications written in dotnet & more recent application written in Java, PHP & nodeJS.

Saas :- Saas in some word a different model then Iaas & paas because it is a licencing agreement to a 3rd party software instead of different deployement model for existing resources that range from data storage to applications. Benifit of standardization for Saas are even more limited than for paas. For Saas, offering Callphone.com, CRM, the user is an end user. However there are other Saas-such as Google maps or Yahoo social in which the user can be a developer who is integrating functionality from these services in to other applications.

Ch. 3 # Scalability & Fault Tolerance

Introduction :

The cloud middleware manages a huge number of resources and users, which depends on the cloud to obtain that they can't obtain within in premises without affording the administrative and maintenance costs.

So in this overall scenario the ability to tolerate failure is normal but sometimes it becomes more important than providing an efficient & optimized system.

The overall conclusion says that "it is a challenging task for the cloud providers to develop such high scalable and and fault tolerance systems who can get managed and at the same time they will provide a competitive performance.

Cloud Scalability :

- In cloud computing, cloud scalability refers to the ability to increase or reduce IT resources as required to meet evolving demands. One of the hallmarks of the cloud and the key factor of its burgeoning popularity with companies is scalability.
- Using existing cloud computing technology, data storage space, processing power & networking can all be escalated. Better still, scaling usually with little or no interruption or downtime, can be achieved rapidly any easily. Third-party cloud providers now have the entire

infrastructure in place; in the past, the process could take weeks or months to scale with on-site physical infrastructure and entail enormous costs.

How to achieve cloud scalability :

- To set up a personalized, scalable cloud solution via a public cloud, private cloud, or hybrid cloud, businesses have several options.
- In cloud computing, two specific forms of scalability exist vertical & horizontal scaling
- We can add or subtract power to an existing cloud server memory upgrade, storage, or computing power with vertical scaling, also known as "scaling up" or "scaling down". This generally indicates that scaling has an upper limit based on the scaling capability of the server or machine; scaling above that also includes downtime.
- We can add more resources like servers to our system using horizontal scalability to spread the workload across computers, which in turn improves efficiency and storage space. For companies with high-availability services that need limited downtime, horizontal scaling is essential.

Cloud Fault Tolerance :

In cloud computing, fault tolerance is conceptually the same as in private or hosted environments. In other words, it means the infrastructure's ability to

continue to provide service / services to underlying applications even when one or more component fails. To continue to work through failure or repair, we do not need to configure certain facilities for our infrastructure to use.

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Objective of fault tolerance :-

The fault tolerance system uses backup components that take the place of failed components automatically ensuring no service loss. They include :

i) Hardware Systems :-

Hardware systems can be backed a by using identical or equivalent systems. For instance, using an identical server running in parallel, with all operations mirrored to the backup server, a server can be made fault tolerant.

ii) Software systems :-

Software systems can be backed a by using software instances. For e.g. it is possible to continuously replicate a database with customer information on another machine & operation can be mechanically redirected to another database ~~instance~~ incase a primary database goes down.

iii) Power Sources :-

power sources use alternative sources using fault tolerant. In many instances, organization have power

generator that can be used in case the Electricity fail. Similarly using redundancy any system or component i.e. a single point of failure can be made fault tolerant.

(v) Security Breach occurrences :-

owing to security failures, there are many explanation about why fault tolerance exists. The servers hacking adversely affects the server & results in a link of data. Ransomware, phishing, viruses attack etc. are other explanation for the need for fault tolerance in the form of security violences.

Key principle behind cloud Computing device fault tolerance :-

The key principles that work behind a fault tolerant device in cloud computing are :

a) Replication
b) Redundancy

a) Replication :-

For every operation, the fault tolerant system operates on the principle of having many other replicates. Therefore if one aspect of the device goes wrong it has other instances that can be put to keep it going instead. For e.g. A database of electronics that has 3 servers with the same information on each of them. All the acts are written in each of them, such as adding data, upgrading data & deleting them. The redundant server

will be in inactive mode unless & until the availability of them is requested by any fault tolerance scheme.

b) Redundancy:

If any part of the system fails or moves to a down state, then it is necessary to have back up systems. For e.g. due to some h/w faults, a website programmer that has MSSQL as its database been fail in between. In the redundancy principle, a server works with an emergency database, comprising of many back up resources.

Techniques for fault tolerance on cloud computing:-

- When developing a fault tolerance scheme, all the facilities have to be given priority. Special priority needs to be given the database since it drives many other units.
- The enterprise has to work on the next after deciding the objectives. For e.g. take the company's form website, which allows the user to login & make comments. If any problem causes the authentication services to main function, users may not be able to login. The platform then becomes a read only one & does not fulfill the objective. But fault tolerant system & the user will search for details with minimal effect.

Cloud Solution :-

- Cloud based solution refers to on demand services, computer demands networks storage application or resources, access via the internet & through provider based cloud computing infrastructure.
- The benifit of cloud business include increased capacity, scalability, functionality & reduced maintenance & cost for computer infrastructure & in hole staff the ability to access cloud based solution from any where with an internet connection wide spread adoption for smart phone & faster network ability, to access cloud based solution from anywhere & anytime as the adoption rate of cloud based solution continues to increase & small to businesses, the price point have bigome affordable SMBs.

Cloud ecosystem :-

- A cloud ecosystem is a computer system of interdependent components that all work together to enable cloud services.
- In nature and ecosystem is compose on living & nonliving that are connected & work together. In cloud computing the ecosystem consist of hardware & software cloud customer cloud engineer, consultance, integrater & partner manager vendor, CEO, CTO ect amazon first composed the cloud to an ecosystem. In a key network address of the cloud

Connect 2011 conference, at that time enterprise cloud computing was usually thought of in terms of IaaS broad service access infrastructure as a service, platform as a service, vogels propose that the cloud was really more complete & its description also needed to include the array of service provider that companies really on to operate on the cloud.

How a cloud ecosystem work :-

The center of a cloud ecosystem is a public cloud provider it might be IAAS provider amazon webservices or a SaaS vender such as sales force radiating out from the center for the out some of the companies provide anchor platform, as well as consultance and companies that have form strategy analysis with the anchor provider there is no vender lock in because these company overlap making the ecosystem more complex a reverse ecosystem provide cloud provider customers with an easy way to find and purchase business application and respond to changing business needs. When the apps should through a provider appstore such as amazon market place, microsoft azure market place for cloud software or microsoft app source for business application. The customer essentialy gives to a catelog of differentiation vendors s/w & services that have

already being accessed and review for security risk & cost.

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Benifits of cloud eco-system :-

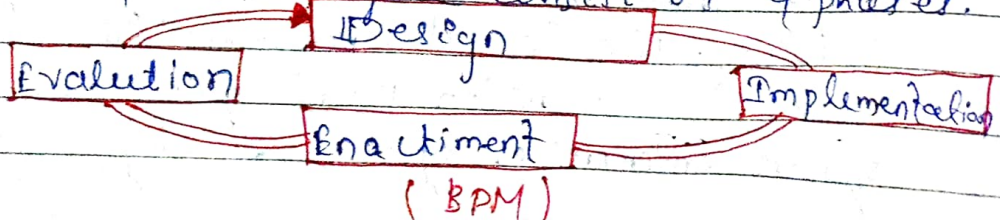
Companies can use a ecosystem to build new business model. It becomes relatively easy for a medical device, ~~m~~ two launch a heard monitoring service on its cloud service provider cloud infra-structure & then sell the service along side its main business of manufacturing heard monitor.

- In a cloud ecosystem it is also easily to execute data & analyse how each part of the system affect the other first.
e.g. If an echo system consist of presence record, smart device logs & healthcare provider records of becomes possibility to analyse pattern across an entire presence population.

Business process Management :-

Every enterprise made up of multiple division both define process regarding how is does business.

Business Process Management (BPM) is a continuous cycle of evaluation & improving organizational process.
The BPM life cycle consist of 4 phases.



(BPM)

Design phase :-

It is consist of identifying existing procedures & capturing this business processes into process model.

Implementation :- It is deployes the results of the design of phase. A BPM package can be used to house the processes.

Enactiment :-

The Enactiment phase is the runtime phase where the business process are deployed into production all monitor by a BPMS.

Evaluation phase :-

The evaluation phase monitor the information gather through the enactiment phase & uses it to receive the business process action finding of the evaluation phase are the input for next interaction life cycle.

When BPM is placed in the cloud, activity that are non-computation-intensive might result in high resource use & linked to high cost as a solution data can be security, Hard more chiefly on premise & only computation intensive can pc replay in the cloud. Any business process such as payroll, accounting or e-commerce delivered as a service over the internet & accesible by pc & smart device can consider to be a business process as a service (BPaaS) for e.g. You are dyning in a restaurant & your father choose an incoming client to approach a purchase order. He is able to approch it right from the table with having to go into the office. This is the reselling how enterprises work today with pad you can access your enterprise system in any where.

Cloud portability & Interoperability :-

26/04/023

Virtual Desktop infrastructure :-

- virtual desktop infrastructure or VDI is define as the hosting of desktop environment on a central server.
- It is a form of desktop virtualization, as the specific desktop images user within virtual machine and are delivery to as client over a network.
- VDI is a concept in which a selection based on a server based computing model that is not so different from the traditional terminal source centralized computing model user to delivery application to new user.
- VDI is the name given to a collection of technology & process that dramatically extend the concept of a network desktop.
- It contains on the idea that companies can virtuals there desktop operating system like window xp or vista. using platforms like VMware, ESX or XEN secure and user the secure data center.

VDI Benifits :-

- Data security
- Reduce hardware
- Easy expenditure management
- Mobile work force
- Resource pulling.

Ch. 4

Cloud Management and virtualization Technology

Introduction :

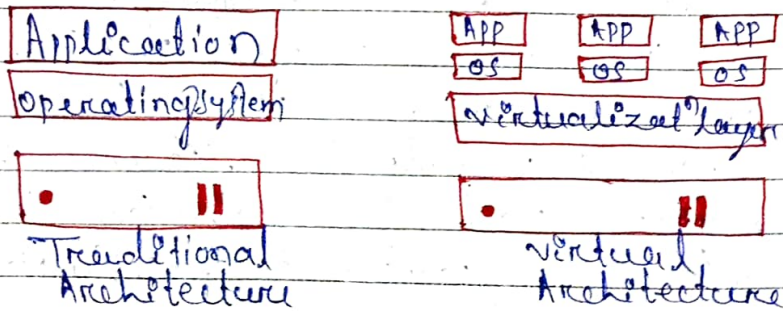
- Cloud management is now administrator control & architecture all products and services that operate in a cloud : the user and access control, data, application & services. It is about giving the admins the ability to access the resource they need. automate the process that they want to and make adjustment as needed, while also monitoring usage & cost.
- cloud management tools provide administrative control over the infrastructure, platforms, applications, cloud service provider resources & data that together create a cloud.
- cloud management software is typical deployed into existing cloud environment as virtual machine that contain a data base and or server.
- virtualization is a technique which which allows to share a single physical instant of a resource or an application among multiple customer & organization. It does by assigning an logical name to a physical storage & providing a pointer to that physical source when demanded.

Create virtualized architecture :

- virtualization is a creation of virtual servers, infrastructure devices and computing resources.
- Virtualization changes the h/w & s/w relation and is one of the foundation elements of cloud computing technology.

that helps utilise the capabilities of cloud computing to the full.

- virtualization techniques allow companies to turn virtual there network, storage, servers, data, desktop and applications.
- Creation of a virtual machine overcom existing operating system & h/w is known as h/w virtualization.
- A virtual machine provides an environment that is logic separate from the underline hardware.
- The machine on which the virtual is going to create is known as host machine & that virtual machine is required to as a guest machine.
- This virtual machine is required keep a eye on for use of which is known as hyper visor.



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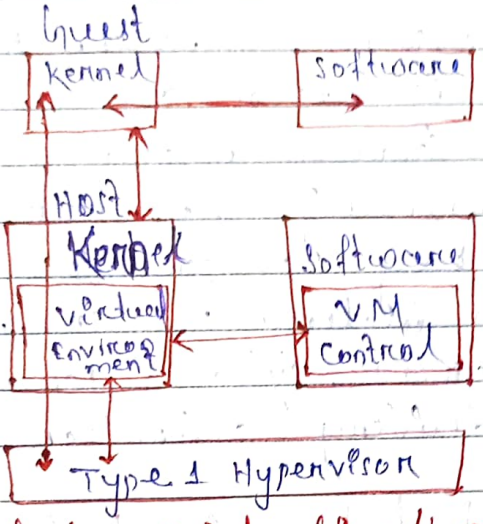
Types of Hardware Virtualization :

Here are the 3 types of hardware virtualization

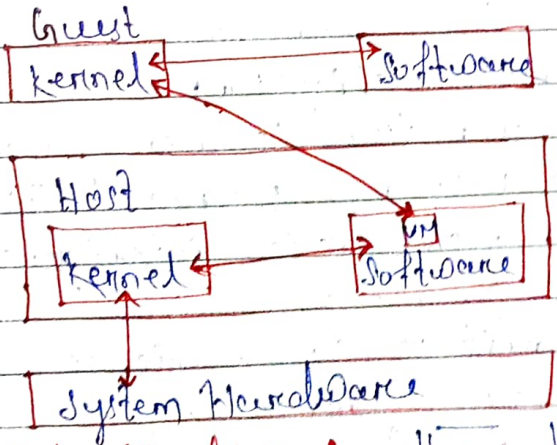
i) Full virtualization
ii) Emulation virtualization
iii) paravirtualization.

i) Full virtualization :- In full virtualization the underlying h/w is completely simulated

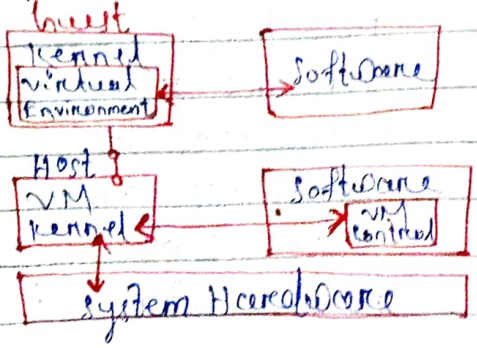
Guest software does not require any modification to run.



(ii) Emulation Virtualization :- In emulation the virtual machine simulates the h/w & hence becomes independent of it. In this the guest operating system does not require modification.



(iii) Paravirtualization :- The hardware is not simulated. The guest s/w run their own isolated domains.



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Data center :-

A data center is a physical facility that organizations used to house there critical applications & data. A data center design is based on a network of computing & storage resources that enable the delivery of shared applications & data. The key components of a data center design include routers, switches, firewalls, storage systems, servers & application delivery controllers.

Importance of data center to business :-

In the world of enterprise IT, data centers are designed to support business applications & activities that include :

- Email & file sharing
- productivity applications
- Customer relationship management (CRM)
- Enterprise resource planning (ERP) & database
- Big data, artificial intelligence & machine learning.
- Virtual desktops, communication & collaboration services.

Core components of a data center :-

A data center design includes routers, switches, firewall, storage system, servers & application delivery controllers. Because these components stored & manage business critical data & applications, data center security is critical in data center design. Together they provide :

i) Network infrastructure :- This connects servers (physical & virtualized), data center services, storage & external connectivity to end-user locations.

ii) Storage infrastructure :- Data is the feed of the modern data center. Storage systems are used to hold this valuable commodity.

iii) Computing resources :- Applications are the engines of a data center. This servers provide the processing, memory, local storage & network connectivity that drives applications.

Types of data centers :-

There are 4 main types of data centers :

a) Enterprise data centers
b) Managed services data centers
c) Co-locations data centers
d) Cloud data centers.

a) Enterprise data centers :- These are built, owned & operated by companies & are optimized for there end users. Most often they are housed on their corporate campus.

b) Managed services data centers :-

These data centers are managed by a third-party (or a managed service provider) on behalf of a company. The company leases the equipment & infrastructure instead of buying it.

c) Colocation data centers :-

In colocation ("colo") data centers, a company rents space within a data center

owned by others & located off company premises. The location data centers hosts the infrastructure building, cooling, bandwidth, security, etc., while the company provides & manages the components including servers, storage & firewall.

d) Cloud data Centers :-

In this of premises form of data center, data & applications are hosted by a cloud service provider such as: Amazon web services (AWS), Microsoft azure or IBM cloud or other public cloud provider.

Resilience :-

Resiliency is the ability of a server, network, storage system or an entire data center to recover quickly & continue operating even when there has been an equipment failure, power outage, or other disruption. Data center resiliency is a planned part of a facility's architecture & is usually associate with other disaster planning & data center disaster recovery consideration such as data protection. The adjective resilient means "having the ability to spring back". Data center resilience is often achieved through the use of redundant components, subsystems, system or facilities. When one element fails or experiences a disruption, the redundant element takes over seamlessly & continues to support competing services

to the user base. Ideally users of a resilocent system never no that a disruption has ever occured.

The resiliency technics employeed in a data center can vary with the importance of the respective workloads. organizations with mission critical workloads will utilize more resiliency technics at moves levels within the data center, because the cost of not recurving critical computing services is typically costlier during a prolonged service outage.

Conversely, non-esential workloads that can tolerate some level of distruction may receive little resiliency or simply remain offline until they can be stored.

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Agility :-

Agility refers to a business's ability to adapt to change quickly in a cost-effective manner. When the business environment needs to tackle the ~~en~~ evolving business environment, agility becomes integral for its survival.

Cloud agility :

- cloud agility refers to the addition of business value. When it comes to cloud context agility is all about the ability of an organization to rapidly developed, test & long ~~to~~ applications that drive business growth.
- cloud agility ensures that businesses are empowered to prioritize issues. Instead of spending valuable time & helps of money

in provisioning & maintaining IT resource, cloud agility speed entails; security, monitoring & analysis.

Some e-advantages of cloud agility are:

i) Quicker time to promote :-

Cloud computing enable business to reduce the time it need for provisioning & deprovisioning IT infrastructure to a considerable extent. Meeting the delivery speed of IT is vital to cost reduction & revenue growth.

Traditionally when business obtain for a physical form, they had to wait for risk to procure & provisions. On the other hand a cloud server does the same in a few minute. Quicker time to promote means quicker time to increase revenue.

ii) Automated Allocation of resources :-

The age of automation allows business to optimize there business process. Cloud computing is used to stream line the provisioning, deprovisioning & deploying IT resources via user friendly online wholesalers, APIs & automation. In a physical environment, an IOT system administrator spend a great deal of time in managing & supporting the on-premises infrastructure. Automations ensures that most of the grooping task are automated so they can focus on more critical issues.

iii) Flexibility :-

Cloud agility provide to organization allowing them to scale up or down there resource to address web traffic &

other demands in order to address sudden or an anticipated production & development needs. The cloud's pay for use flexibility makes sure that end users can rapidly scale as per the organizations production needs.

iv) Adaptive auto scaling :-

The cloud allows you use s/w & APIs to access cloud services & platform. It makes it easier to automate ID provisioning & management while using a cloud ecosystem. There is also an opportunity to integrate analytics & business platforms along with IT monitoring tools. In this way you can make on systems adjustings.

v) Faster innovation :-

cloud agility enables organization to speed of marketing & product development. It aligns IT management & infrastructure costs with there business objectives & goals.

vi) Greater business value :-

- A well design cloud solution boost sure makes present with the following :
- Allows you upgrade the software faster than your competitor.
- Facilited your employees to build on there skills for multiple business areas.
- Ensures that you get to enjoy high availability.
- Makes sure developed that customer uses to reliable & respect product.

Cloud storage :

- cloud storage is a service model in which data is transmitted & stored on remote

storage systems, where it is maintain, manage, back up, & made available to users over a network, typically the internet
- Users generally pay for their cloud data storage on a per-consumption monthly rate.
- Cloud based data is stored in logical pools across discrete commodity storage servers located on premises or on a data center managed by a third-party cloud provider.
- Cloud service providers manage & maintain data transfer to the cloud storage services are provided on demand on the cloud with capacity increasing & decreasing as needed.

Types of cloud storage :

There are 3 main cloud storage options based on different access models : public, private & hybrid.

i) Public :-

These storage services provide a multi tenant storage environment that is most suited for unstructure data on a subscription basis. Data is stored in the service providers data centers with storage data spread across multiple regions or continents. Customers generally pay on a for use basis, similar to utility payment model. The market sector is dominated by the following services: Amazon simple storage service (S3) Amazon glacier for deep archives or cold storage, google cloud storage & microsoft azure.

ii) Private cloud :-

A private cloud storage service is an

in house storage resources deployed as a dedicated environment protected behind firewall, private clouds are appropriate for users who need customization & more control over the data or through have stringent data security or regulatory requires.

iii) Hybrid cloud :-

This cloud storage option is a mix of private cloud storage & third party public cloud storage services with a layer of orchestration management to operationally integrated the 2 platforms. A hybrid environment also makes it easier to handel seasonal or unanticipated spikes in data creed or users by cloud bursting to the external storage service & avoiding having to add in house storage resources.

Cloud storage works varies depending on the type of storage used. The 3 main types are block storage, file storage & object storage.

Block storage :-

Block storage device large volumes of data into smaller unit called blocks. Each block associated with a unique identifier & placed on one of the system storage drives. Block storage is fast, efficient & provides the low latency required by applications such as database & high performance workloads.

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File Storage :-

File storage organizes data in a hierarchy of files & folders. It is commonly used with personal computer storage drives & network attached storage. Data in file storage system is stored in files & the files are stored in folders. Directories & subdirectories are used to organize the folders & locate files & data.

Object Storage :-

Object storage stores data as objects which consists of 3 components : Data stored in a file, Meta data associated with the data file & a unique identifier.

Advantages of cloud storage :-

i) Pay as you go :- With a cloud storage service, customer only pay for the storage they use, eliminating the need for big capital expences.

ii) Utility billing :- Because customers only pay for the ~~capital~~ capacity they use, cloud storage costs can decrease as uses a ducks. This is in stark contrast to using an in house storage system which will likely be over configured to handle anticipated growth.

iii) Global availability :- Cloud storage typical available from any system any where & at any time, where you not have to worry about operating system capability or complex allocat processes

(iv) Ease of use access :- Cloud storage is easy to access & use, so developers, s/w testers & business users can get a & running quickly without having to make, form & IT team to allocate & configure storage resources.

v) offsite security :- By its very nature public cloud storage offers a way to move copies of data to a remote site for backup & security purposes.

Disadvantages :

i) Security :- Data security is the most cited factor that may make companies cautious using public cloud storage. The concern is that once data leaves a company's premises, it no longer has control over how the data is handled & stored.

ii) Data access :- Maintaining access to data stored in the cloud can also be an issue & cloud significantly increase the cost of using cloud storage. A company may need to upgrade its connection to the ISP service to handle the volume of data it expects to transmit.

iii) performance degradation :-

A company may run into performance issues if its in house applications need to access the data it has stored in the cloud. In these cases, it will likely require either moving the servers & applications into the same cloud or

bringing the necessary back in house.

iv) Cost :- If a company requires a lot of cloud storage capacity & frequently moves its data back & forth bet^n on premises system the cloud, the monthly costs can be high. Compared to developing the storage in house, the ongoing costs cloud eventually set pass the cost of implementing & maintaining the unpremise system.

Cloud provisioning :-

- Cloud provisioning is the allocating of a cloud provider resources & services to a customer.
- Cloud provisioning is a key feature of the cloud computing model, relating to how a customer procures cloud services & resources from a cloud provider.
- The growing catalog of cloud services that customers can provision includes infrastructure as a service (IaaS) s/w as a service (SaaS) & platform as a service (PaaS). In public or private cloud environment.

Types of cloud provisioning :-

The cloud provisioning process can be conducted using one of the 3 delivery models. Each delivery model differs depending on the kinds of resources or services an organization purchases, how & when the cloud provider

deliver those resources & services & how the customer pays for them. Th 3 models are
i) Advanced provisioning.
ii) Dynamic "
iii) User self "

i) Advanced provisioning :-
With advanced provisioning, the customer signs a formal contract with service with the cloud provider. The provider then prepares the agreed upon resources & services for the customer & delivers them. The customer is charged a flat fee or billed on a monthly basis.

ii) Dynamic provisioning :-
With dynamic provisioning, cloud resources are deployed flexible to match a customer's fluctuating demands. Cloud deployment typically scale up to accommodate spikes in use & scale down when demands decrease. The customer is billed on a pay for use basis.

iii) User self provisioning :-
With user self provisioning also called cloud self service, the customer buys resources from the cloud provider through the web interface or portal. This usually involves creating a user account & paying for resources with a credit card & these resources are then quickly spend up & made available for use within hours, if not minutes.

Cloud provisioning Tools & Software :-

Organizations can manually provision what ever resources & services they need but public cloud provider often tools to provision multiple resources & services like :

- AWS cloud formation.
- Microsoft azure resource manager
- Google cloud deployement manager
- IBM cloud orchestrator.

Alternatively third-party tools for cloud resource provisioning include the following : CloudBolt, scalr (formaly embotics), commander Morpheus Data.

Cloud Asset Management :-

Cloud Asset Management (CAM) is a component of cloud management services focused exclusively on the management of a business's physical cloud environment such as the product or services they use.

- CAM keeps track of every aspect of your cloud estate, managing the maintenance, compliance, upgrading & disposal of cloud assets.
- By ensuring this processes run smoothly, companies keep the benefits of their cloud infrastructure while only spending what they need.
- Cloud asset management delivered visibility & control of all the assets & infrastructure that make of your cloud environment. It is a crucial first step

forward as better optimized, more secure cloud.

- It enables your business to effectively keep track of your cloud estate while maintaining the smooth running of your cloud infrastructure. For real time visibility of your cloud inventory.

Benifits of cloud Asset of management ?

i) Inventory accuracy :-

A key advantage of cloud asset management is the ability to give greater visibility over your cloud estate. CAM systems can gather indepth inventory information that can be used make educated decission about managing your assets in the most cost effective manner possible.

ii) Automation :- CAM uses automated processing to instantly manage the discovery of your assets & provide real time, upto date inventory information. Not only can automation reduces the time consuming process of trawling through large amounts of data, it also removes human error from cloud asset management, boosting the accuracy of your cloud management processes.

iii) Security assurance :-

CAM firms of your business cloud security package, enabling you to keep track of your critical

security measures with actionable assessment of potential risks & threats to your cloud infrastructure. Automated systems can fix vulnerabilities upon detection; without human intervention ensuring your business is not left with critical security gaps.

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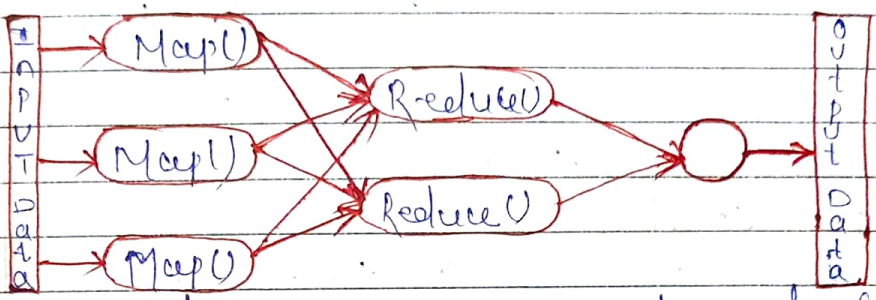
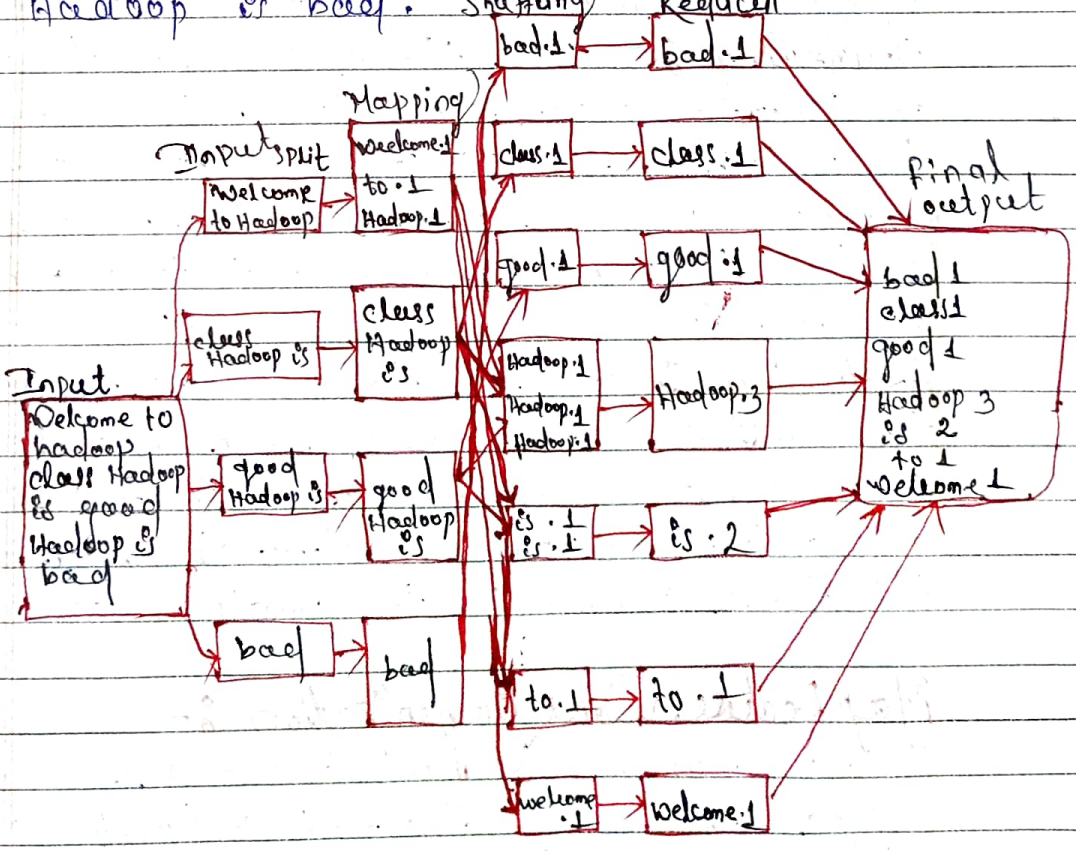
Concept of Map Reduce:

- Map Reduce is a software framework & programming model used for processing huge amounts of data.
- Map Reduce program work in two phases, namely, Map & Reduce.
- Map tasks deal with splitting & mapping of data while Reduce tasks shuffle & reduce the data.
- Hadoop is capable of running MapReduce programs written in various languages: Java, Ruby, Python & C++.
- The programs of Map Reduce in cloud computing are parallel in nature, thus are very useful for performing large-scale data analysis using multiple machines in the cluster.
- The input to each phase is key-value pairs. In addition, every programmer needs to specify two functions: Map function & reduce function.

Map Reduce Architecture ?



- The whole process goes through four phases of execution namely, splitting, mapping, shuffling, and reducing.
- e.g. Consider you have following input data for your Map reduce in Bigdata program.
Welcome to Hadoop class, Hadoop is good, Hadoop is bad.



The final output of the MapReduce task is
bad 1, class 1, good 1, Hadoop 3, is 2, to 1,
welcome 1

- The data goes through the following phases of MapReduce in Big Data.

Input Splits:

An input to a MapReduce in Big data job is divided into fixed size pieces called input splits. Input split is a chunk of the input that is consumed by a single map.

Mapping :- This is very 1st phase in the execution of map-reduce program. In this phase data in each split is passed to a mapping function to produce output values.

Shuffling :- This phase consumes the output of Mapping phase. Its task is to consolidate the relevant records from mapping phase output. In our eg., the same words are clubbed together along with their respective frequency.

Reducing :- In this phase, output values from the shuffling phase are aggregated. This phase combines values from shuffling phase and returns a single output value. In short, this phase summarizes the complete dataset.

MapReduce Work Organization :-

Hadoop divided the job into tasks. There are 2 types of tasks : i) Map tasks (splits & Mapping)
ii) Reduce tasks (shuffling, Reducing)

- The complete execution process (execution of map & Reduce tasks, both) is controlled by 2 types of entities called a

1. Jobtracker: Acts like a master (responsible for complete execution of submitted job)
2. Multiple Task Trackers: Acts like slaves, each of them performing the job.

For every job submitted for execution in the system, there is one jobtracker that resides on Namenode and there are multiple tasktrackers which reside on Datanode.

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Cloud Governance:

- Cloud Governance is a framework that guides how end users make use of cloud services by defining & creating policy to control costs, minimize security risks, improve efficiency & accelerate deployment.
- It is imperative to have good cloud Governance because it is a foundational element to your cloud practice that provide the ability to scale & be successful.
- The cloud provided capabilities are very powerful & can potentially bring many inconsistencies & resource ownership issues into the environment such as:
  i) Who created the resource
  ii) For what purpose.
- The shift from Unpremises IT adds layers of complexity to your infrastructure architecture.
- It also means that more people across your organization have the potential to impact that architecture because any

one can create resource without being held responsible to decomition them.
- Therefore it is imperative to create a maintain a comprihensive cloud Governance model.

Load Balancing :-
- Cloud load balancing is the process of distributing workloads & computing resources in a cloud computing environment.
- Load balancing allows enterprises to manage applications or workload demands by allocating resources among multiple computers, networks or servers.
- Cloud load balancing involves hosting the distribution of workload traffic & demands that reside over the internet.
- It helps enterprises achive high performance level for potentially lower costs than traditional on premises load balancing technology.
- It takes advantage of the cloud's scalability & agility to meet repeated workload demands & to improve overall availability.
- Many cloud providers offer cloud load balancing technologies including amazon web services (AWS), Google, Microsoft azure & Rackspace. AWS offers elastic load balancing, which distributes workloads & traffic among EC2 instances. Google cloud platform offers load balancing for its infrastructure as a service, Google compute engine which distribute network traffic between vertical instance

instances. Microsoft azure's Traffic Manager distributes traffic for the cloud services across multiple data centers. Rack spaces cloud load balancer uses multiple servers for workload distribution.

High availability :-

- High availability (HA) is the ability of a system to operate continuously without failing for a designated period of time.
- HA work to ensure a system meets an agreed upon operational performance level.
- HA on the cloud is achieved by creating clusters.
- A HA cluster is a group of servers that act as a single server to provide continuous uptime.
- These servers will have access to the same shared storage for data, so if a server is unavailable, the other servers pick up the load.
- A HA cluster can be anything from 2-dozen of servers. As well as providing fail over, high availability cluster also allow load balancing of work load so that many one servers within the cluster will not get overloaded & you can provide more consistent performance.
- HA can be simply defined by a simple equation **HA = MTBF / (MTBF * MTTR)**

where,

MTBF is the mean time between failure.
MTTR is the mean time to repair a HA

is high availability.
There are 2 ways to improve the availability.
- Increase MTBF to very large values.
- Reduce MTTR to very low value.

Disaster Recovery :-

- Cloud disaster recovery is a cloud computing service which allows for storing & recovering system data on a remote cloud based platform.
- The primary goal of disaster recovery is to minimize the over all impact of disaster on business performance.
- Due to its cost efficiency, scalability & reliability, disaster recovery in cloud computing has become the most lucrative option for small or medium sized business (SMBs).
- Generally SMBs do not have a sufficient budget for resources to build & maintain there own disaster recovery site. cloud providers often access to cloud storage which can become a cost effective & long lasting solution to data protection as well as disaster recovery.
- An effective cloud based disaster recovery plan should include the following steps:
  i) perform a risk assesment & business impact analysis.
  ii) Choose prevention, Preparedness, response, recovery measures.
  iii) Test & update your cloud based disaster recovery plan.

Strategies of disaster Recovery :-

i) RTO (Recovery Time Objective) :-

RTO is the period of time within which system, application or functions must be discovered after an outage. RTO are often use as the basis for the development of recovery strategy & as determinent as to whether or not to implement the recovery strategy during a disaster situation.

ii) RPO (Recovery point objective) :-

- RPO is the point to time to which systems data must be recovered after an outage.
- RPO are often use as the basis for the development of backup strategy & as a determinent of the amount of data that may need to be recreated after the systems or functions have been recovered.