SEC-302-CLOUD COMPUTING UNIT-1

Introduction of Cloud Computing:-

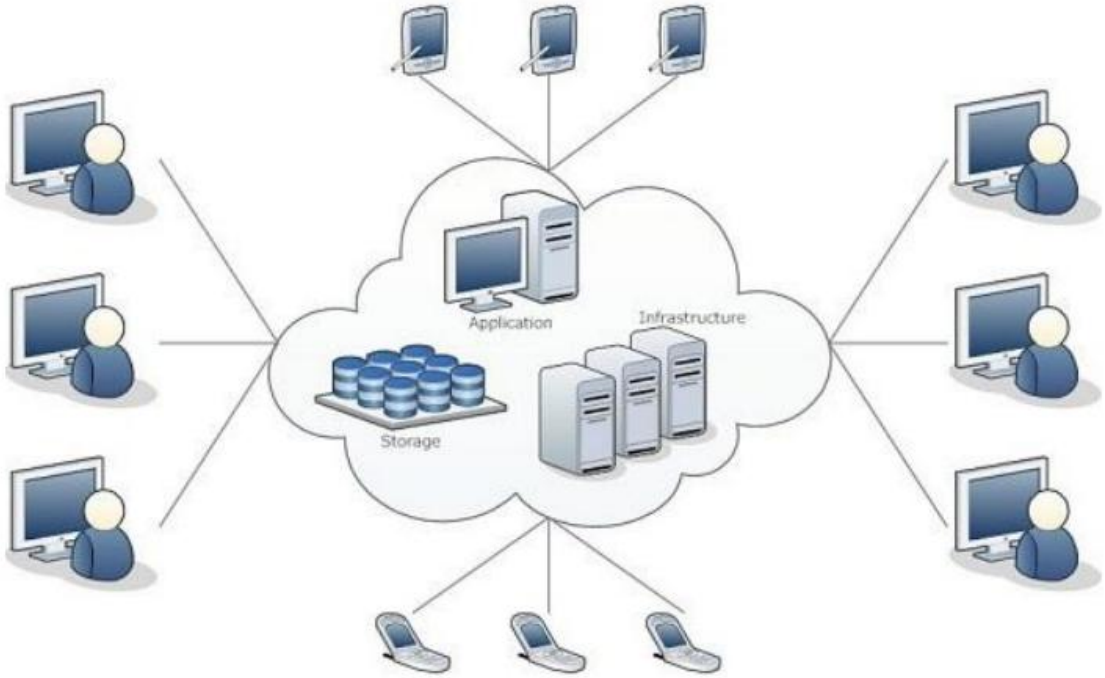
Cloud Computing provides us a means by which we can access the applications as utilities, over the Internet. It allows us to create, configure, and customize applications online.

What is Cloud?

The term Cloud refers to a Network or Internet. In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over network, i.e., on public networks or on private networks, i.e., WAN, LAN or VPN. Applications such as e-mail, web conferencing, customer relationship management (CRM), all run in cloud.

What is Cloud Computing?

Cloud Computing refers to manipulating, configuring, and accessing the applications online. It offers online data storage, infrastructure and application. We need not to install a piece of software on our local PC and this is how the cloud computing overcomes platform dependency issues. Hence, the Cloud Computing is making our business application mobile and collaborative.



Cloud computing at a glance:

National Institute of Standards and Technology (US Department of Commerce) defines Cloud Computing as "A model for enabling everywhere, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimum management effort or service provider interaction." Simply put, it means to store and process

data over the internet instead of one's own personal storage/processing device, the 'Cloud' is just a synonym for the network infrastructure that provides this service (paid or free) and hence it can be accessed from anywhere through an internet connection.

If you are using any of the following then you are trust on the Cloud:

- Social Media (Facebook, LinkedIn, MySpace, Twitter)
- E-Mail (Gmail, Hotmail, Yahoo Mail)
- Online storage of photographs (Flickr, Picasa)
- Google Docs
- Entertainment (YouTube, Netflix)
- Online file storage (Dropbox, Google Drive, Box)
- Web hosting services (GoDaddy, Big Rock)

The vision of cloud computing:

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

These are following Vision of Cloud Computing:

1. Cloud computing provides the facility to provision virtual hardware, runtime environment and services to a person having money.
2. These all things can be used as long as they are needed by the user.
   The whole collection of computing system is transformed into collection of utilities, which can be provisioned and composed together to deploy systems in hours rather than days, with no maintenance cost.
3. The long term vision of a cloud computing is that IT services are traded as utilities in an open market without technological and legal barriers.

4. In the future, we can imagine that it will be possible to find the solution that matches with our requirements by simply entering out request in a global digital market that trades with cloud computing services.
5. The existence of such market will enable the automation of discovery process and its integration into its existing software systems.
6. Due to the existence of a global platform for trading cloud services will also help service providers to potentially increase their revenue.
7. A cloud provider can also become a consumer of a competition service in order to fulfill its promises to customers.
8. In the near future we can imagine a solution that suits our needs by simply applying our application to the global digital market for cloud computing services.
9. The presence of this market will enable the acquisition process to automatically integrate with its integration into its existing software applications. The availability of a global cloud trading platform will also help service providers to increase their revenue.
10. A cloud provider can also be a buyer of a competitive service to fulfill its promises to customers.

A closer look of Cloud Computing :

According to the National Institute of Standard and Technology (NIST), "Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction." The essential characteristics of cloud computing are:

Flexibility:

- Cloud-based services are most required by businesses that are currently growing at a rapid pace, and therefore, have fluctuating bandwidth demands.
- If yours is such a business, your company's needs will only keep increasing.
- Fortunately, it is quite easy to boost your cloud capacity by drawing on your service provider's remote servers.
- The flexibility is inbuilt in the service. The level of agility can provide businesses with a real advantage over competitors.

Disaster Recovery:

- Businesses, irrespective of their sizes, are not entirely safe from unforeseen disasters, whether technological, natural or accidental.
- In the unfortunate event that your business has to go through a disaster, how do you ensure business continuity?
- Cloud services enable real-time backup of data, and they have recovery solutions in place.
- This way, you can significantly reduce downtime and ensure your business keeps performing as usual.

Automatic updates:

- The good thing about cloud computing is that the systems are not only out of your premises but also out of your systems.
- Thus, you do not need to invest time in maintaining the systems.
- You can just entrust the service providers with the responsibility, and they will roll out regular updates. These include security updates too so that you do not have to worry about your systems' security on top of a hundred other things.
- You can now focus on matters that are truly important in terms of ensuring the growth of your business.

Enhanced collaboration:

- With this technology, you are ensuring that your teams can collaborate from anywhere at any time. No matter where the team members are located at the particular time, they can easily access data and work together for the success of the project.
- Don't worry! Even with this real-time connectivity, you can ensure your data's security with identity and access management solutions.

Security:

- Security, understandably, is one of the primary concerns of business leaders when it comes to Cloud.
- However, Cloud computing offers you heightened data security.
- You can put various blog device and access management solutions in place to make sure that your data is not accessible to any unauthorized individual, but just in case mobile devices with work data are accidentally lost, you can also wipe the devices clean remotely to prevent data theft.

The cloud computing Reference Model:

The reference model for cloud computing is an abstract model that characterizes and standardizes a cloud computing environment by partitioning it into abstraction layers and cross-layer functions.

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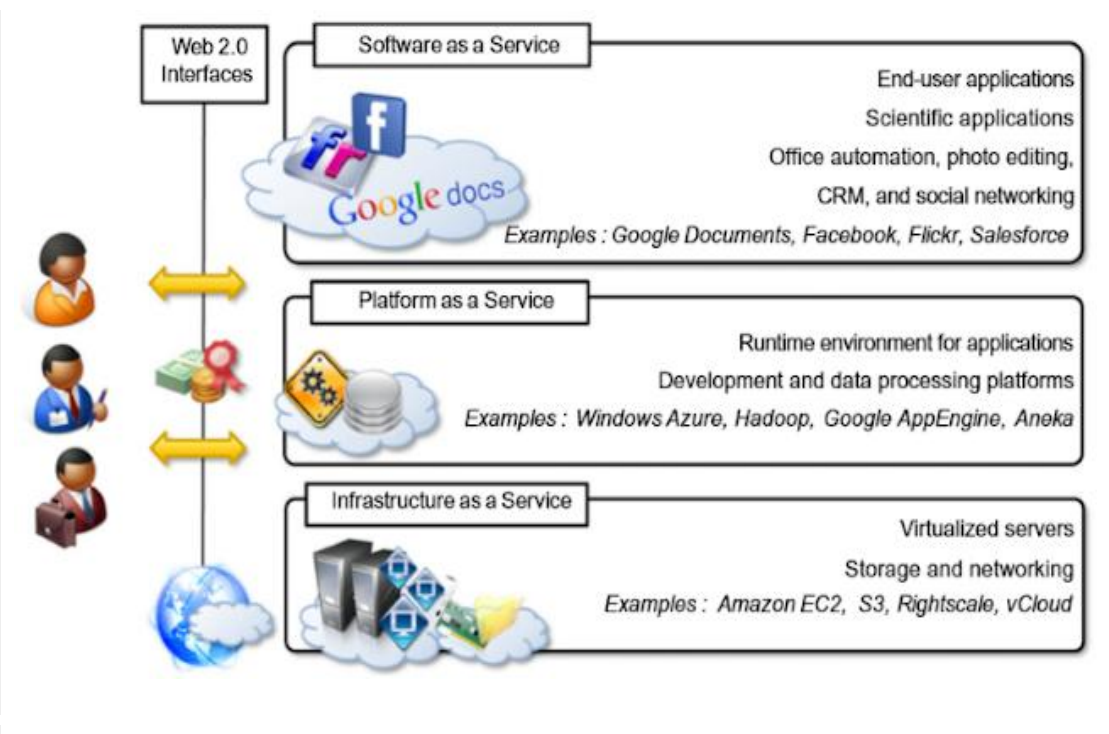

If we look in to the reference model as seen in above image we will find classification of Cloud Computing services:

1. Infrastructure-as-a-Service (IaaS),
2. Platform-as-a-Service (PaaS), and
3. Software-as-a-Service (SaaS).
4. Web 2.0

1. Infrastructure as a service (IaaS) is a cloud computing offering in which a vendor provides users access to computing resources such as servers, storage and networking.

2. Platform as a service (PaaS) is a cloud computing offering that provides users with a cloud environment in which they can develop, manage and deliver applications.

3. Software as a service (SaaS) is a cloud computing offering that provides users with access to a vendor's cloud-based software. Users do not install applications on their local devices. Instead, the applications reside on a remote cloud network accessed through the web or an API. Through the application, users can store and analyze data and collaborate on projects.

4. Web 2.0 is the term used to describe a variety of web sites and applications that allow anyone to create and 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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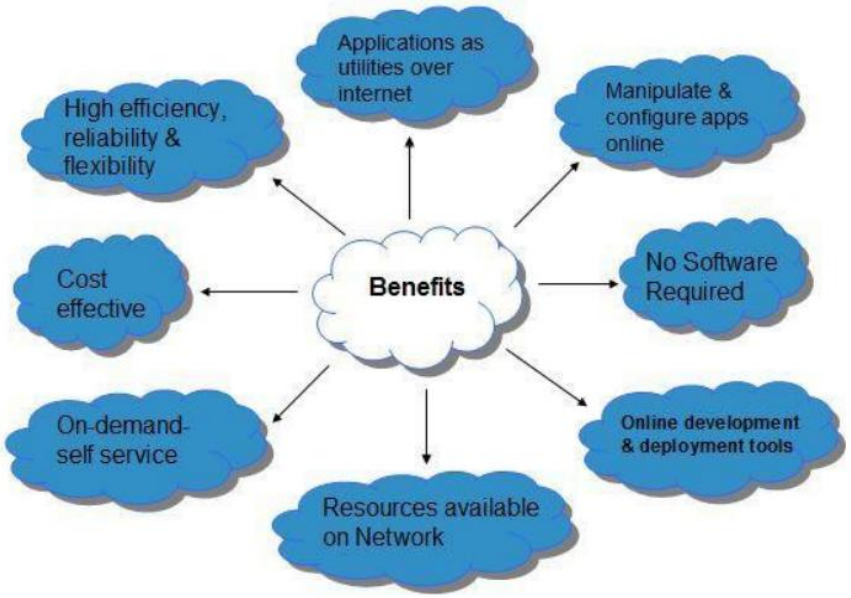
Benefits of Cloud Computing:

- One can access applications as utilities, over the Internet.
- Manipulate and configure the application online at any time
- It does not require to install a specific piece of software to access or manipulate cloud application.
- Cloud Computing offers online development and deployment tools, programming runtime environment through Platform as a Service model.
- Cloud resources are available over the network in a manner that provides platform independent access to any type of clients.
- Cloud Computing offers on-demand self-service. The resources can be used without interaction with cloud service provider.
- Cloud Computing is highly cost effective because it operates at higher efficiencies with greater utilization. It just requires an Internet connection.
- Cloud Computing offers load balancing that makes it more reliable.



Limitation of Cloud Computing

- We do not have physical control over the data.
- Our data center is remote and we may not control the connectivity of the data center.
- Limited control of physical resources.
- Security is provided by a third party to a certain level.
- Possibility of unwanted shutdown.

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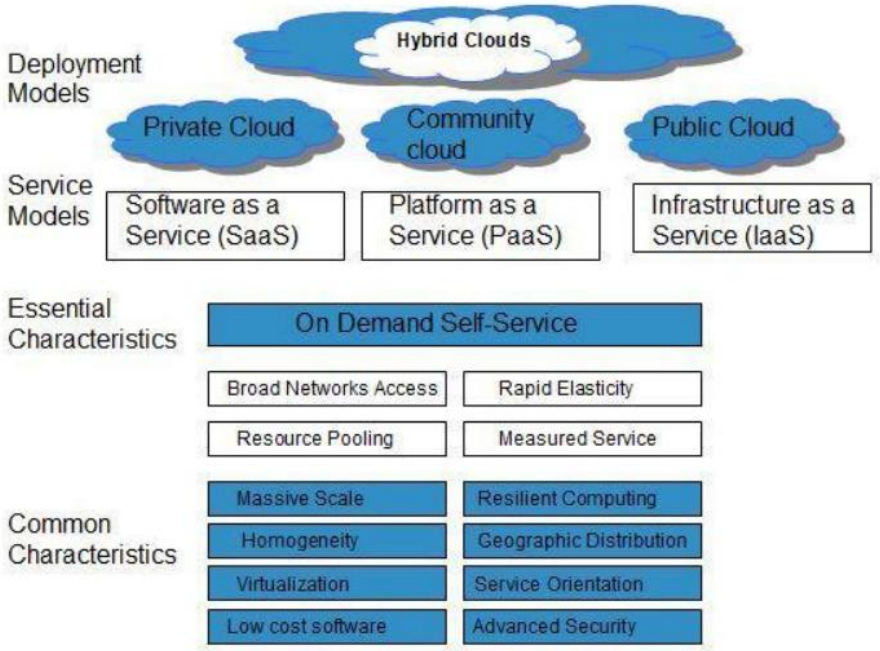
Characteristics of Cloud Computing:



1. RESOURCES POOLING

Resource pooling is one of the essential characteristics of Cloud Computing. Resource pooling means that a cloud service provider can share resources among several clients, providing everyone with a different set of services as per their requirements. It is a multi-client strategy that can be applied to data storage services, processing services, and bandwidth provided services. The administration process of allocating resources in real-time doesn't conflict with the client's experience.

2. ON-DEMAND SELF-SERVICE

It is one of the significant and essential features of Cloud Computing. It enables the client to constantly monitor the server uptime, abilities, and allotted network storage. This is a fundamental characteristic of Cloud Computing, and a client can likewise control the computing abilities as per his needs.

3. EASY MAINTENANCE

This is one of the best cloud characteristics. The servers are effortlessly maintained, and the downtime remains low or absolutely zero sometimes. Cloud Computing powered resources undergo several updates frequently to optimize their capabilities and potential. The updates are more viable with the devices and perform quicker than the previous versions.

Prepared By:- Asst. Prof. Nirav Shukla(CPICA)

4. SCALABILITY AND RAPID ELASTICITY

A key characteristic and benefit of cloud computing is its rapid scalability. This cloud characteristic enables cost-effective running of workloads that require a vast number of servers but only for a short period. Many clients have such workloads, which can be run very cost-effectively because of the rapid scalability of Cloud Computing.

5. ECONOMICAL

This cloud characteristic helps in reducing the IT expenditure of the organizations. In Cloud Computing, the client needs to pay the administration for the space they have used. There is no covered up or additional charge which needs to be paid. The administration is economical, and more often than not, some space is allotted for free.

6. MEASURED AND REPORTING SERVICE

Reporting services are one of the many cloud characteristics that make it the best choice for organizations. Measuring & reporting service is helpful for both cloud providers and their clients. It enables both the provider and the client to monitor and report what services have been used and for what purpose. This helps in monitoring billing and ensuring the optimum usage of resources.

7. SECURITY

Data security is one of the best characteristics of Cloud Computing. Cloud services create a copy of the data that is stored to prevent any form of data loss. If one server loses the data by any chance, the copy version is restored from the other server. This feature comes handy when several users work on a particular file in real-time and a file suddenly gets corrupted.

8. AUTOMATION

Automation is an essential characteristic of cloud computing. The ability of cloud computing to automatically install, configure, and maintain a cloud service is known as automation in cloud computing. In simple terms, it is the process of making the most of technology and reducing manual effort. However, to achieve automation in the cloud ecosystem is not so easy. It requires the installation and deployment of virtual machines, servers, and large storage. Upon successful deployment, these resources require constant maintenance as well.

9. RESILIENCE

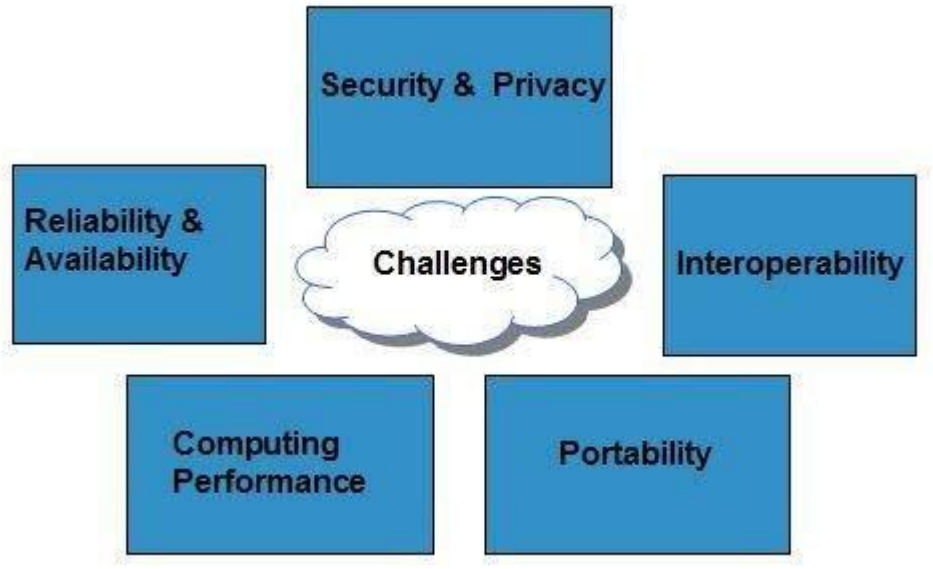
Resilience in cloud computing means the ability of the service to quickly recover from any interruption. A cloud's resilience is measured by how fast its servers, databases, and network system restarts and recovers from any kind of harm or damage. Availability is another major characteristic of cloud computing. Since cloud services can be accessed remotely, there is no geographic restriction or limitation when it comes to utilizing cloud resources.

10. LARGE NETWORK ACCESS

A big part of the cloud characteristics is its ubiquity. The client can access the cloud data or transfer the data to the cloud from any place just with a device and internet connection. These capacities are accessible everywhere in the organization and get to with the help of the internet. Cloud providers save that large network access by monitoring and guaranteeing different measurements that reflect how clients access cloud resources and data: latency, access time, data throughput, etc.

Challenges Ahead of Cloud Computing:

Cloud computing, an emergent technology, has placed many challenges in different aspects of data and information handling. Some of these are shown in the following diagram:



- **SECURITY AND PRIVACY:**

Security and Privacy of information is the biggest challenge to cloud computing. Security and privacy issues can be overcome by employing encryption, security hardware and security applications.

- **PORTABILITY**

This is another challenge to cloud computing that applications should easily be migrated from one cloud provider to another. There must not be vendor lock-in. However, it is not yet made possible because each of the cloud providers uses different standard languages for their platforms.

- **INTEROPERABILITY**

It means the application on one platform should be able to incorporate services from the other platforms. It is made possible via web services, but developing such web services is very complex.

- **COMPUTING PERFORMANCE**

Data intensive applications on cloud require high network bandwidth, which results in high cost. Low bandwidth does not meet the desired computing performance of cloud application.

- **RELIABILITY AND AVAILABILITY**

It is necessary for cloud systems to be reliable and robust because most of the businesses are now becoming dependent on services provided by third-party.

❖ Historical Developments of Cloud Computing:

Cloud computing is all about renting computing services. This idea first came in the 1950s. In making cloud computing what it is today, five technologies played a vital role. These are distributed systems and its peripherals, virtualization, web 2.0, service orientation, and utility computing.

- **Distributed Systems:**

It is a composition of multiple independent systems but all of them are depicted as a single entity to the users. The purpose of distributed systems is to share resources and also use them effectively and efficiently. Distributed systems possess characteristics such as scalability, concurrency, continuous availability, heterogeneity, and independence in failures. But the main problem with this system was that all the systems were required to be present at the same geographical location. Thus to solve this problem, distributed computing led to three more types of computing and they were-Mainframe computing, cluster computing, and grid computing.

- **Virtualization:**

  It was introduced nearly 40 years back. It refers to the process of creating a virtual layer over the hardware which allows the user to run multiple instances simultaneously on the hardware. It is a key technology used in cloud computing. It is the base on which major cloud computing services such as Amazon EC2, VMware vCloud, etc work on. Hardware virtualization is still one of the most common types of virtualization.

- **Web 2.0:**

  It is the interface through which the cloud computing services interact with the clients. It is because of Web 2.0 that we have interactive and dynamic web pages. It also increases flexibility among web pages. Popular examples of web 2.0 include Google Maps, Facebook,

Twitter, etc. Needless to say, social media is possible because of this technology only. In gained major popularity in 2004.

Build Cloud Computing Environments:

Cloud environments can be a source of reduced cost. One of the biggest cost savings is the transition from capital expense to operational expense. When setting up a traditional environment, the infrastructure and equipment have to be purchased ahead of time. This equipment is usually purchased as part of an organization's capital budget. In a cloud environment, you don't have to worry about purchasing the equipment; you only pay for the service. The cost of the service will usually count against an organization's operational budget. Generally, it's easier to get operational expenses approved than to get capital expenses approved. In addition, traditional cloud environments are built using utility storage and utility computing. These are generally cheaper than more specialized components.

Cloud Computing Platforms and Technologies :

Cloud computing applications develops by organizing platforms and frameworks. Various types of services are provided from the bare metal infrastructure to customize-able applications serving specific purposes. Companies like Google, Facebook, Amazon, Microsoft, etc. have spent millions of dollars building their Data Centres (Clouds) to provide their services on the internet. In the past few years, some of these companies have opened up their cloud services to the public. Hence, anyone with a laptop and an internet connection can start a business on the internet through the power of cloud computing platforms. Compute, Storage and Cost are the most important parameters to decide on a Cloud computing platform.

(1) Amazon Web Services (AWS) :-

AWS provides different wide-ranging clouds IaaS services, which ranges from virtual compute, storage, and networking to complete computing stacks. AWS is well known for its storage and compute on demand services, named as Elastic Compute Cloud (EC2) and Simple Storage Service (S3). EC2 offers customizable virtual hardware to the end user which can be utilizing as the base infrastructure for arranging computing systems on the cloud. It is likely to choose from a large variety of virtual hardware configurations including GPU and cluster instances. Either the AWS console, which is a wide-ranged Web portal for retrieving AWS services, or the web services API available for several programming language is used to deploy the EC2 instances. EC2 also offers the capability of saving an explicit running instance as image, thus allowing users to create their own templates for deploying system. S3 stores these templates and delivers persistent storage on demand. S3 is well ordered into buckets which contain objects that are stored in binary form and can be grow with attributes. End users can store objects of any size, from basic file to full disk images and have them retrieval from anywhere. In addition, EC2 and S3, a wide range of services can be leveraged to build virtual computing system including: networking support, caching system, DNS, database support, and others.

(2) Google AppEngine :–

Google AppEngine is a scalable runtime environment frequently dedicated to executing web

applications. These utilize benefits of the large computing infrastructure of Google to dynamically scale as per the demand. AppEngine offers both a secure execution environment and a collection of which simplifies the development if scalable and high-performance Web applications. These services include: in-memory caching, scalable data store, job queues, messaging, and corn tasks. Developers and Engineers can build and test applications on their own systems by using the AppEngine SDK, which replicates the production runtime environment, and helps test and profile applications. On completion of development, Developers can easily move their applications to AppEngine, set quotas to containing the cost generated, and make it available to the world. Currently, the supported programming languages are Python, Java, and Go.

(3) **Microsoft Azure** :–

Microsoft Azure is a Cloud operating system and a platform in which user can develop the applications in the cloud. Generally, a scalable runtime environment for web applications and distributed applications is provided. Application in Azure are organized around the fact of roles, which identify a distribution unit for applications and express the application's logic. Azure provides a set of additional services that complement application execution such as support for storage, networking, caching, content delivery, and others.

(4) Hadoop: –

Apache Hadoop is an open source framework that is appropriate for processing large data sets on commodity hardware. Hadoop is an implementation of MapReduce, an application programming model which is developed by Google. This model provides two fundamental operations for data processing: map and reduce. Yahoo! Is the sponsor of the Apache Hadoop project, and has put considerable effort in transforming the project to an enterprise-ready cloud computing platform for data processing. Hadoop is an integral part of the Yahoo! Cloud infrastructure and it supports many business processes of the corporates. Currently, Yahoo! Manges the world's largest Hadoop cluster, which is also available to academic institutions.