What is Cloud Computing?

Cloud computing refers to applications and services that run on a distributed network using virtualized resources and accessed by common Internet protocols and networking standards. It is distinguished by the notion that resources are virtual and limitless and that details of the physical systems on which software runs are abstracted from the user.

What are the different types of clouds?

Public Cloud

Public clouds are managed by third parties which provide cloud services over the internet to the public, these services are available as pay-as-you-go billing models. They offer solutions for minimizing IT infrastructure costs and become a good option for handling peak loads on the local infrastructure. Public clouds are the go-to option for small enterprises, which can start their businesses without large upfront investments by completely relying on public infrastructure for their IT needs.

Private cloud

Private clouds are distributed systems that work on private infrastructure and provide the users with dynamic provisioning of computing resources. Instead of a pay-as-you-go model in private clouds, there could be other schemes that manage the usage of the cloud and proportionally billing of the different departments or sections of an enterprise. Private cloud providers are HP Data Centers, Ubuntu, Elastic-Private cloud, Microsoft, etc.

Hybrid cloud:

A hybrid cloud is a heterogeneous distributed system formed by combining facilities of the public cloud and private cloud. For this reason, they are also called **heterogeneous clouds.**

A major drawback of private deployments is the inability to scale on-demand and efficiently address peak loads. Here public clouds are needed. Hence, a hybrid cloud takes advantage of both public and private clouds.

Community cloud:

Community clouds are distributed systems created by integrating the services of different clouds to address the specific needs of an industry, a community,

or a business sector. But sharing responsibilities among the organizations is difficult.

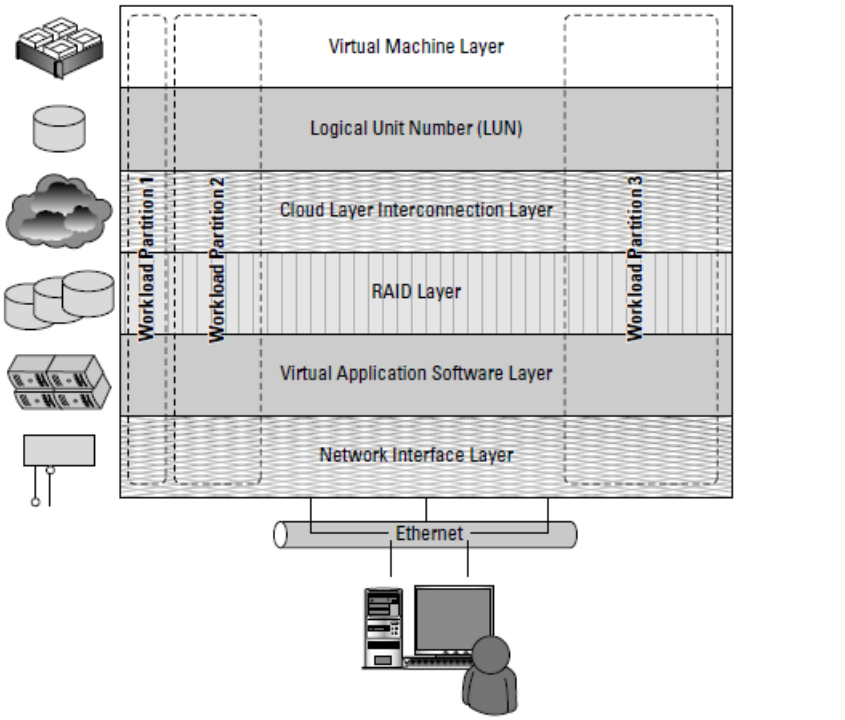
In the community cloud, the infrastructure is shared between organizations that have shared concerns or tasks. An organization or a third party may manage the cloud.

What are the different cloud service models?

Infrastructure as a Service: Infrastructure as a Service (IaaS) is a cloud computing service model in which hardware is virtualized in the cloud. In this particular model, the service vendor owns the equipment: servers, storage, network infrastructure, and so forth. The developer creates virtual hardware on which to develop applications and services. Essentially, an IaaS vendor has created a hardware utility service where the user provisions virtual resources as required.

FIGURE 4.2

A virtual private server partition in an IaaS cloud



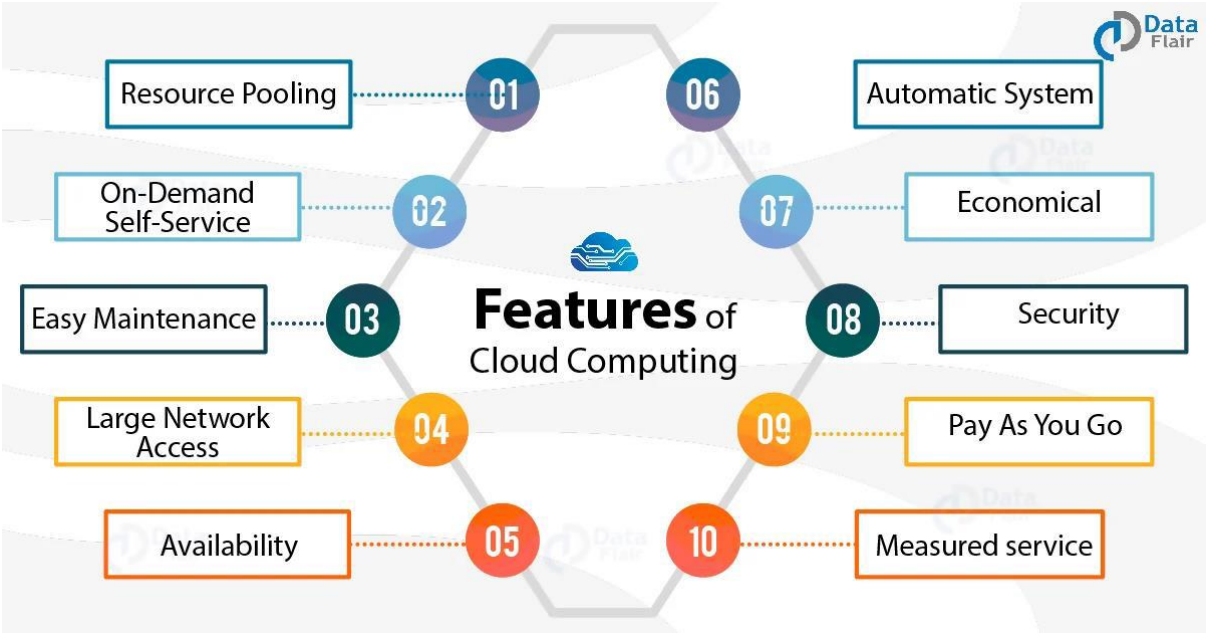
Platform as a Service: In a PaaS model, customers may interact with the software to enter and retrieve data, perform actions, get results, and to the degree that the vendor allows it, customize the platform involved. The customer takes no responsibility for maintaining the hardware, the software, or the development of the applications and is responsible only for his interaction with

the platform. The vendor is responsible for all the operational aspects of the service, for maintenance, and for managing the product(s) lifecycle.

Software as a Service: The most complete cloud computing service model is one in which the computing hardware and software, as well as the solution itself, are provided by a vendor as a complete service offering. It is referred to as the Software as a Service (SaaS) model. SaaS provides the complete infrastructure, software, and solution stack as the service offering. A good way to think about SaaS is that it is the cloud-based equivalent of shrink-wrapped software.

Software as a Service (SaaS) may be succinctly described as software that is deployed on a hosted service and can be accessed globally over the Internet, most often in a browser. With the exception of the user interaction with the software, all other aspects of the service are abstracted away.

What are the characteristics of Cloud Computing?



1. Resources Pooling

It means that the Cloud provider pooled the computing resources to provide services to multiple customers with the help of a multi-tenant model.

2. On-Demand Self-Service

It is one of the important and valuable features of Cloud Computing as the user can continuously monitor the server uptime, capabilities, and allotted network storage.

3. Easy Maintenance

The servers are easily maintained and the downtime is very low and even in some cases, there is no downtime.

4. Large Network Access

The user can access the data of the cloud or upload the data to the cloud from anywhere just with the help of a device and an internet connection.

5. Availability

The capabilities of the Cloud can be modified as per the use and can be extended a lot.

6. Automatic System

Cloud computing automatically analyses the data needed and supports a metering capability at some level of services.

7. Economical

It is the one-time investment.

8. Security

Cloud Security, is one of the best features of cloud computing. It creates a snapshot of the data stored so that the data may not get lost even if one of the servers gets damaged.

9. Pay as you go

In cloud computing, the user has to pay only for the service or the space they have utilized. There is no hidden or extra charge which is to be paid.

10. Measured Service

Cloud Computing resources used to monitor and the company uses it for recording. This resource utilization is analyzed by supporting charge-per-use capabilities.

What are the benefits of Cloud Computing?

On-demand self-service: A client can provision computer resources without the need for interaction with cloud service provider personnel.

l **Broad network access:** Access to resources in the cloud is available over the network using standard methods in a manner that provides platform-independent access to clients of all types. This includes a mixture of heterogeneous operating systems, and thick and thin platforms such as laptops, mobile phones, and PDA.

l **Resource pooling:** A cloud service provider creates resources that are pooled together in a system that supports multi-tenant usage. Physical and virtual

systems are dynamically allocated or reallocated as needed. Intrinsic in this concept of pooling is the idea of abstraction that hides the location of resources such as virtual machines, processing, memory, storage, and network bandwidth and connectivity.

l **Rapid elasticity:** Resources can be rapidly and elastically provisioned. The system can add resources by either scaling up systems (more powerful computers) or scaling out systems (more computers of the same kind), and scaling may be automatic or manual. From the standpoint of the client, cloud computing resources should look limitless and can be purchased at any time and in any quantity.

l **Lower costs:** Because cloud networks operate at higher efficiencies and with greater utilization, significant cost reductions are often encountered.

l **Ease of utilization:** Depending upon the type of service being offered, you may find that you do not require hardware or software licenses to implement your service.

l **Quality of Service:** The Quality of Service (QoS) is something that you can obtain under contract from your vendor.

l **Reliability:** The scale of cloud computing networks and their ability to provide load balancing and failover makes them highly reliable, often much more reliable than what you can achieve in a single organization.

l **Outsourced IT management:** A cloud computing deployment lets someone else manage your computing infrastructure while you manage your business. In most instances, you achieve considerable reductions in IT staffing costs.

What is Cloud Architecture?

Cloud architecture is a key element of building in the cloud. It refers to the layout and connects all the necessary components and technologies required for cloud computing.

Migrating to the cloud can offer many business benefits compared to on-premises environments, from improved agility and scalability to cost efficiency. While many organizations may start with a “lift-and-shift” approach, where on-premises applications are moved over with minimal modifications, ultimately it will be necessary to construct and deploy applications according to the needs and requirements of cloud environments.

Cloud architecture dictates how components are integrated so that you can pool, share, and scale resources over a network. Think of it as a building blueprint for running and deploying applications in cloud environments.

What are different components of Cloud Computing?

Application

Application in backend refers to a software or platform to which client accesses. Means it provides the service in backend as per the client requirement.

Service

Service in backend refers to the major three types of cloud-based services like SaaS, PaaS and IaaS. Also manages which type of service the user accesses.

Runtime Cloud in backend provides the execution and Runtime platform/environment to the Virtual machine.

Storage

Storage in backend provides flexible and scalable storage service and management of stored data.

Infrastructure

Cloud Infrastructure in backend refers to the hardware and software components of cloud like it includes servers, storage, network devices, virtualization software etc.

Management

Management in backend refers to management of backend components like application, service, runtime cloud, storage, infrastructure, and other security mechanisms etc.

Security

Security in backend refers to implementation of different security mechanisms in the backend for secure cloud resources, systems, files, and infrastructure to end-users.

Internet

Internet connection acts as the medium or a bridge between frontend and backend and establishes the interaction and communication between frontend and backend.

Database

Database in backend refers to provide database for storing structured data, such as SQL and NOSQL databases. Example of Databases services include Amazon RDS, Microsoft Azure SQL database and Google Cloud SQL.

Networking

Networking in backend services that provide networking infrastructure for application in the cloud, such as load balancing, DNS and virtual private networks.

Analytics

Analytics in backend service that provides analytics capabilities for data in the cloud, such as warehousing, business intelligence and machine learning.

Virtualization is technology that you can use to create virtual representations of servers, storage, networks, and other physical machines. Virtual software mimics the functions of physical hardware to run multiple virtual machines simultaneously on a single physical machine. Businesses use virtualization to use their hardware resources efficiently and get greater returns from their investment. It also powers cloud computing services that help organizations manage infrastructure more efficiently.

What are different types of Virtualizations?

Server virtualization

Server virtualization is a process that partitions a physical server into multiple virtual servers. It is an efficient and cost-effective way to use server resources and deploy IT services in an organization. Without server virtualization, physical servers use only a small amount of their processing capacities, which leave devices idle.

Storage virtualization

Storage virtualization combines the functions of physical storage devices such as network attached storage (NAS) and storage area network (SAN). You can pool the storage hardware in your data center, even if it is from different vendors or of different types. Storage virtualization uses all your physical data storage and creates a large unit of virtual storage that you can assign and control by using management software. IT administrators can streamline storage

activities, such as archiving, backup, and recovery, because they can combine multiple network storage devices virtually into a single storage device.

Network virtualization

Any computer network has hardware elements such as switches, routers, and firewalls. An organization with offices in multiple geographic locations can have several different network technologies working together to create its enterprise network. Network virtualization is a process that combines all of these network resources to centralize administrative tasks. Administrators can adjust and control these elements virtually without touching the physical components, which greatly simplifies network management.

Data virtualization

Modern organizations collect data from several sources and store it in different formats. They might also store data in different places, such as in a cloud infrastructure and an on-premises data center. Data virtualization creates a software layer between this data and the applications that need it. Data virtualization tools process an application's data request and return results in a suitable format. Thus, organizations use data virtualization solutions to increase flexibility for data integration and support cross-functional data analysis.

What is Load Balancing?

Load balancing is the method of distributing network traffic equally across a pool of resources that support an application. Modern applications must process millions of users simultaneously and return the correct text, videos, images, and other data to each user in a fast and reliable manner. To handle such high volumes of traffic, most applications have many resource servers with duplicate data between them. A load balancer is a device that sits between the user and the server group and acts as an invisible facilitator, ensuring that all resource servers are used equally.

What is Hypervisor?

A hypervisor is a software that you can use to run multiple virtual machines on a single physical machine. Every virtual machine has its own operating system

and applications. The hypervisor allocates the underlying physical computing resources such as CPU and memory to individual virtual machines as required. Thus, it supports the optimal use of physical IT infrastructure.

What is Machine Imaging?

A machine image is a Compute Engine resource that stores all the configuration, metadata, permissions, and data from multiple disks of a virtual machine (VM) instance. You can use a machine image in many system maintenance, backup and recovery, and instance cloning scenarios.

Difference between SaaS and PaaS.

Basis Of	IAAS	PAAS	SAAS
Stands for	Infrastructure as a service.	Platform as a service.	Software as a service.
Uses	IAAS is used by network architects.	PAAS is used by developers.	SAAS is used by the end user.
Access	IAAS gives access to the resources like virtual machines and virtual storage.	PAAS gives access to run time environment to deployment and development tools for application.	SAAS gives access to the end user.
Model	It is a service model that provides virtualized computing resources over the internet.	It is a cloud computing model that delivers tools that are used for the development of applications.	It is a service model in cloud computing that hosts software to make it available to clients.
Technical understanding.	It requires technical knowledge.	Some knowledge is required for the basic setup.	There is no requirement about technicalities company handles everything.

Popularity	It is popular among developers and researchers.	It is popular among developers who focus on the development of apps and scripts.	It is popular among consumers and companies, such as file sharing, email, and networking.
Percentage rise	It has around a 12% increment.	It has around 32% increment.	It has about a 27 % rise in the cloud computing model.
Usage	Used by the skilled developer to develop unique applications.	Used by mid-level developers to build applications.	Used among the users of entertainment.
Cloud services.	Amazon Web Services, sun, vCloud Express.	Facebook, and Google search engine.	MS Office web, Facebook and Google Apps.
Enterprise services.	AWS virtual private cloud.	Microsoft Azure.	IBM cloud analysis.
Outsourced cloud services.	Salesforce	Force.com, Gigaspaces.	AWS, Terremark

ef=shm

What are Application Frameworks?

An application framework is a software library that provides a fundamental structure to support the development of applications for a specific environment. An application framework acts as the skeletal support to build an application. The intention of designing application frameworks is to lessen the general issues faced during the development of applications. This is achieved through the use of code that can be shared across different modules of an application. Application frameworks are used not only in the graphical user interface (GUI) development, but also in other areas like web-based applications.

What is Cloud Infrastructure?

Cloud Infrastructure is the collection of hardware and software elements such as computing power, networking, storage, and virtualization resources needed to enable cloud computing. Cloud infrastructure types usually also include a user interface (UI) for managing these virtual resources. Infrastructure as a Service, or IaaS, is a prominent and accessible example of this model. With IaaS, a team or enterprise acquires the computing infrastructure it needs over the Internet, including computing power (whether on physical or, more likely, virtual machines), storage, and plenty of related needs such as load balancers and firewalls. They do this in lieu of provisioning and managing their own physical infrastructure. Instead, they lease the resources they need from the IaaS provider.

What is Cloud Monitoring?

Cloud monitoring is the process of evaluating the health of cloud-based IT infrastructures. Using cloud-monitoring tools, organizations can proactively monitor the availability, performance, and security of their cloud environments to find and fix problems before they impact the end-user experience.

Cloud monitoring comprises a series of strategies and practices for analyzing, tracking, and managing cloud-based services and applications. As businesses scale their infrastructure and digital footprint, it becomes vitally important for IT administrators and DevOps teams to maintain visibility into the performance of their digital assets. Cloud monitoring provides an efficient way to achieve this visibility while providing an enterprise with actionable insights to improve availability and user experiences.

What are the Amazon Web Services components and services?

AWS or the Amazon Web Services is Amazon's cloud computing platform that offers a mix of packaged software as a service (SaaS), platform as a service (PaaS), and infrastructure as a service (IaaS). In 2006, Amazon launched AWS from its internal infrastructure that was used for handling online retail operations. It was one of the first companies to provide users with computing,

throughput, and storage as needed on the basis of pay-as-you-go cloud computing model.

Data Management and Data Transfer

To run HPC applications in the AWS cloud, you need to move the required data into the cloud. There are several data transport solutions designed to securely transfer huge amounts of data. This overcomes issues like a long time for transfer, high network costs, and security concerns. Also, you can automate the movement of data between the AWS cloud and on-premises storage. There are options for establishing a private connection to the AWS from your premises. This increases bandwidth to provide more throughput, reduces the cost of the network, and provides a consistent network experience.

Compute & Networking

There are several compute instances types that can be customized according to your needs. It also handles monitoring your application and adjusting its capacity for maintaining a steady and predictable performance at an affordable cost. Also, setting up application scaling across multiple services for multiple resources takes a few minutes. Enhanced networking options from AWS allow achieving lower inter-instance latency and higher bandwidth.

Storage

When looking for an HPC solution, you need to consider the storage options and cost. There are several flexible blocks, object, and file storage options in AWS services that allow permanent and transient data storage. It allows allocating storage volumes according to the size you need. You can store and access and data type over the cloud without doing a data migration project. Also, with AWS services, you can transfer your workload to the cloud from on-premises.

Visualization

With the AWS services, you can easily visualize the engineering simulations' results without moving huge amounts of data. Now, you can access the

interactive applications remotely over a standard network and deliver application sessions to any workstation.

Security and Compliance

For running applications on the cloud, you need to have an understanding of regulatory compliance and security management. There are several quick-launch templates and security related services offered by AWS that helps in protecting data and customer privacy by putting strong safeguards in the AWS infrastructure.

Amazon Web Services offers the following services for various computing purposes:

- Hosting a web site
- Social networking
- Academic computing
- Sharing media
- Hosting applications
- Backup, storage, and disaster recovery
- Media distribution and content delivery
- Developing and testing environments
- Search engines

What are Cloud Security Concerns?

Data Loss – Data Loss is one of the issues faced in Cloud Computing. This is also known as Data Leakage. As we know that our sensitive data is in the hands of Somebody else, and we don't have full control over our database. So, if the security of cloud service is to broken by hackers, then it may be possible that hackers will get access to our sensitive data or personal files. **Interference of Hackers and Insecure API's –** As we know, if we are talking about the cloud and its services it means we are talking about the Internet. Also, we know that the easiest way to communicate with Cloud is using API. So, it is important to protect the Interface's and API's which are used by an external user. But also in cloud computing, few services are available in the public domain which are the vulnerable part of Cloud Computing because

it may be possible that these services are accessed by some third parties. So, it may be possible that with the help of these services hackers can easily hack or harm our data.

Denial of Service (DoS) attack – This type of attack occurs when the system receives too much traffic. Mostly DoS attacks occur in large organizations such as the banking sector, government sector, etc. When a DoS attack occurs, data is lost. So, in order to recover data, it requires a great amount of money as well as time to handle it.

What are Virtual Appliances?

A virtual appliance is a common deployment object in the cloud, and it is one area where there is considerable activity and innovation. One of the major advantages of a virtual appliance is that you can use the appliances as the basis for assembling more complex services, the appliance being one of your standardized components. Virtual appliances remove the need for application configuration and maintenance from your list of system management chores.

What is Identity?

An identity is a set of characteristics or traits that make something recognizable or known. In computer network systems, it is one's digital identity that most concerns us. A digital identity is those attributes and metadata of an object along with a set of relationships with other objects that makes an object identifiable. Not all objects are unique, but by definition a digital identity must be unique, if only trivially so, through the assignment of a unique identification attribute. An identity must therefore have a context in which it exists.

What is Elastic Compute Cloud (EC2)?

Amazon Elastic Compute Cloud (EC2) is a virtual server platform that allows users to create and run virtual machines on Amazon's server farm. With EC2, you can launch and run server instances called Amazon Machine Images (AMIs) running different operating systems such as Red Hat Linux and Windows on servers that have different performance profiles. You can add or subtract virtual servers elastically as needed; cluster, replicate, and load balance servers; and locate your different servers in different data centers or "zones" throughout the world to provide fault tolerance. The term *elastic* refers to the ability to size your capacity quickly as needed.