Module-1

MODULE-1	Introduction to Cloud Computing	21CSE642.1	8 Hours

Cloud Computing Definition, Historical Evolution of Cloud Computing, Benefits and Advantages of Cloud Computing, Cloud Service Models: IaaS, PaaS, SaaS, Cloud Deployment Models: Public, Private, Hybrid, Community, Cloud Computing Providers: AWS, Azure, Google Cloud, and Others.

Cloud Computing:

The term cloud refers to a network or the internet. It is a technology that uses remote servers on the internet to store, manage, and access data online rather than local drives. The data can be anything such as files, images, documents, audio, video, and more.

There are the following operations that we can do using cloud computing:

- o Developing new applications and services
- o Storage, back up, and recovery of data
- o Hosting blogs and websites
- o Delivery of software on demand
- o Analysis of data
- o Streaming videos and audios

Why Cloud Computing?

Small as well as large IT companies, follow the traditional methods to provide the IT infrastructure. That means **for any IT company, we need a Server Room that is the basic need of IT companies**.

In that server room, there should be a database server, mail server, networking, firewalls, routers, modem, switches, QPS (Query Per Second means how much queries or load will be handled by the server), configurable system, high net speed, and the maintenance engineers.

To establish such IT infrastructure, we need to spend lots of money. To overcome all these problems and to reduce the IT infrastructure cost, Cloud Computing comes into existence.
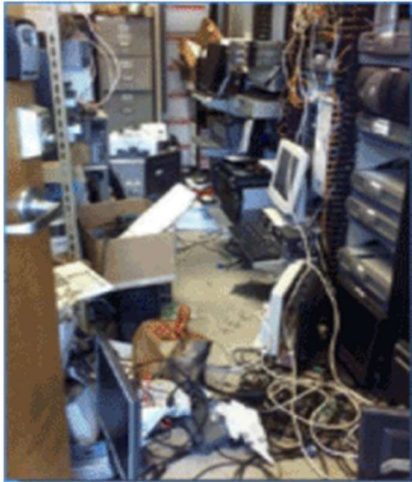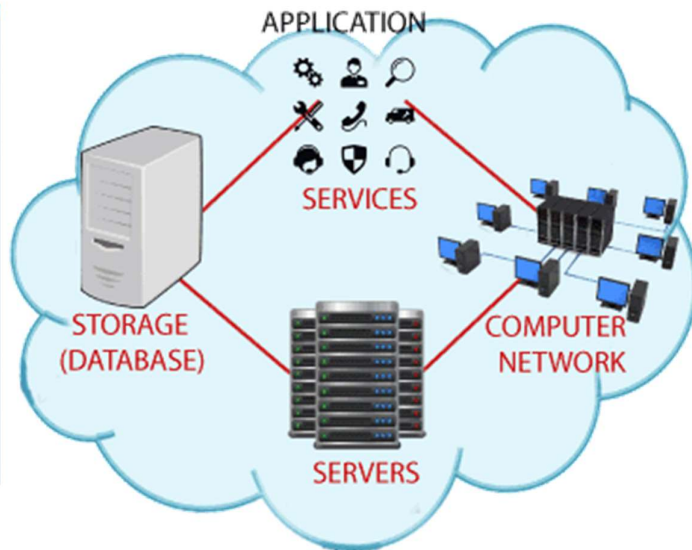
Characteristics of Cloud Computing

The characteristics of cloud computing are given below:

1) Agility

The cloud **works in a distributed computing environment**. It shares resources among users and works very fast.

2) High availability and reliability

The availability of servers is high and more reliable because the **chances of infrastructure failure are minimum**.

3) High Scalability

Cloud offers **"on-demand" provisioning of resources on a large scale**, without having engineers for peak loads.

4) Multi-Sharing

With the help of cloud computing, **multiple users and applications can work more efficiently** with cost reductions by sharing common infrastructure.

5) Device and Location Independence

Cloud computing enables the users to access systems using a web browser regardless of their location or what device they use e.g. PC, mobile phone, etc. **As infrastructure is off-site** (typically provided by a third-party) **and accessed via the Internet, users can connect from anywhere**.

6) Maintenance

Maintenance of cloud computing applications is easier, since they **do not need to be installed on each user's computer and can be accessed from different places**. So, it reduces the cost also.

7) Low Cost

By using cloud computing, the cost will be reduced because to take the services of cloud computing, **IT company need not to set its own infrastructure** and pay-as-per usage of resources.

8) Services in the pay-per-use mode

Application Programming Interfaces **(APIs) are provided to the users so that they can access services on the cloud** by using these APIs **and pay the charges as per the usage of services**.

Evolution 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.

Evolution of Cloud Computing
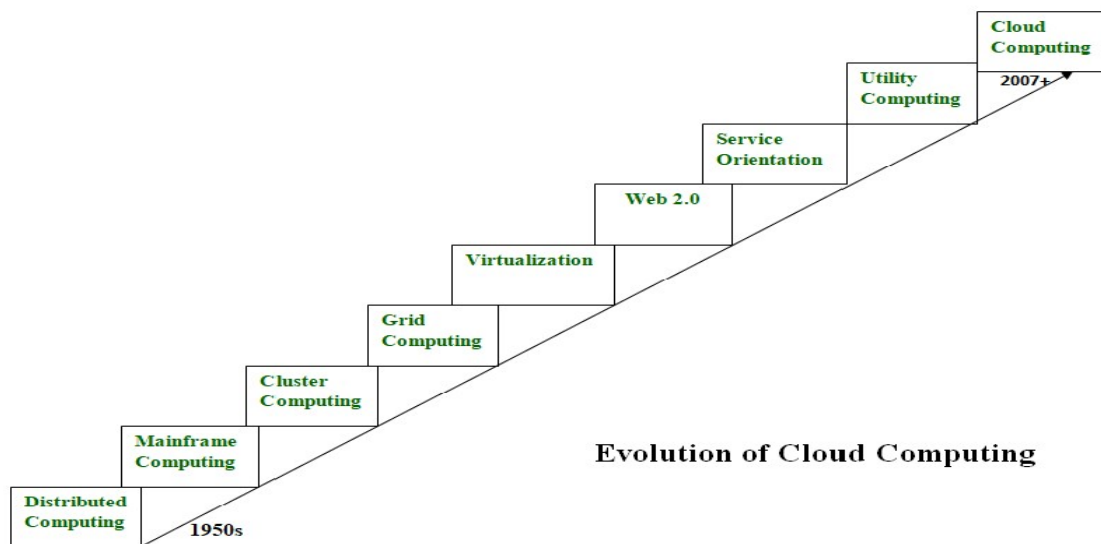
- **Distributed Systems:**
  It is a composition of multiple independent systems but all of them are depicted as a single entity to the users. The purpose of distributed systems is to share resources and also use them effectively and efficiently. Distributed systems possess characteristics such as scalability, 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.

- **Mainframe computing:**
  Mainframes which first came into existence in 1951 are highly powerful and reliable computing machines. These are responsible for handling large data such as massive input-output operations. Even today these are used for bulk processing tasks such as online transactions etc. These systems have almost no downtime with high fault tolerance. After distributed computing, these increased the processing capabilities of the system. But these were very expensive. To reduce this cost, cluster computing came as an alternative to mainframe technology.

- **Cluster computing:**
  In 1980s, cluster computing came as an alternative to mainframe computing. Each machine in the cluster was connected to each other by a network with high bandwidth. These were way cheaper than those mainframe systems. These were equally capable of high computations. Also, new nodes could easily be added to the cluster if it was required. Thus, the problem of the cost was solved to some extent but the problem related to geographical restrictions still pertained. To solve this, the concept of grid computing was introduced.

- **Grid computing:**
  In 1990s, the concept of grid computing was introduced. It means that different systems were placed at entirely different geographical locations and these all were connected via the internet. These systems belonged to different organizations and thus the grid consisted of heterogeneous nodes. Although it solved some problems but new problems emerged as the distance between the nodes increased. The main problem which was encountered was the low availability of high bandwidth connectivity and with it other network associated issues. Thus. cloud computing is often referred to as "Successor of 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. It gained major popularity in 2004.

- **Service orientation:**
  It acts as a reference model for cloud computing. It supports low-cost, flexible, and evolvable applications. Two important concepts were introduced in this computing model. These were Quality of Service (QoS) which also includes the SLA (Service Level Agreement) and Software as a Service (SaaS).

- **Utility computing:**
  It is a computing model that defines service provisioning techniques for services such as compute services along with other major services such as storage, infrastructure, etc which are provisioned on a pay-per-use basis.

Advantages and Disadvantages of Cloud Computing

Advantages of Cloud Computing

- Almost every company switched their services on the cloud to rise the company growth.
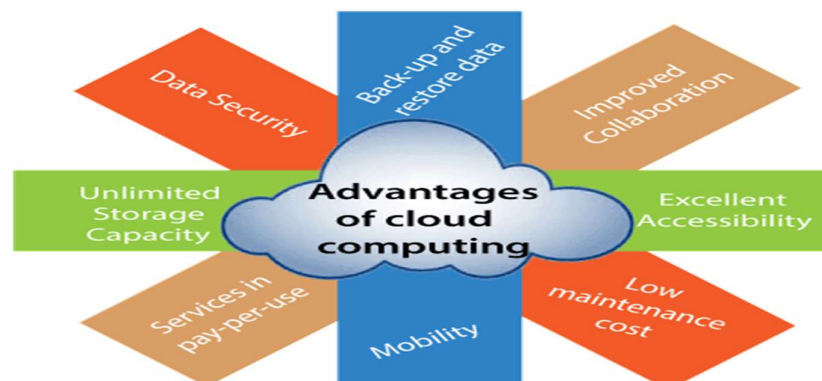
- 1) Back-up and restore data
- Once the data is stored in the cloud, it is easier to get back-up and restore that data using the cloud.
- 2) Improved collaboration

- Cloud applications improve collaboration by allowing groups of people to quickly and easily share information in the cloud via shared storage.

3) Excellent accessibility

- Cloud allows us to quickly and easily access store information anywhere, anytime in the whole world, using an internet connection. An internet cloud infrastructure increases organization productivity and efficiency by ensuring that our data is always accessible.

4) Low maintenance cost

- Cloud computing reduces both hardware and software maintenance costs for organizations.

5) Mobility

- Cloud computing allows us to easily access all cloud data via mobile.

6) IServices in the pay-per-use model

- Cloud computing offers Application Programming Interfaces (APIs) to the users for access services on the cloud and pays the charges as per the usage of service.

7) Unlimited storage capacity

- Cloud offers us a huge amount of storing capacity for storing our important data such as documents, images, audio, video, etc. in one place.

8) Data security

- Data security is one of the biggest advantages of cloud computing. Cloud offers many advanced features related to security and ensures that data is securely stored and handled.

Disadvantages of Cloud Computing

1) Internet Connectivity

- In cloud computing, every data (image, audio, video, etc.) is stored on the cloud, and we access these data through the cloud by using the internet connection. If you do not have good internet connectivity, you cannot access these data. However, we have no any other way to access data from the cloud.

2) Vendor lock-in

- Vendor lock-in is the biggest disadvantage of cloud computing. Organizations may face problems when transferring their services from one vendor to another. As different vendors provide different platforms, that can cause difficulty moving from one cloud to another.

3) Limited Control

cloud infrastructure is completely owned, managed, and monitored by the service provider, so the cloud users have less control over the function and execution of services within a cloud infrastructure.

4) Security

- Although cloud service providers implement the best security standards to store important information. But, before adopting cloud technology, you should be aware that you will be sending all your organization's sensitive information to a third party, i.e., a cloud computing service provider. While sending the data on the cloud, there may be a chance that your organization's information is hacked by Hackers.

Cloud Service Models

There are the following three types of cloud service models -

1. Infrastructure as a Service (IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)

Infrastructure as a Service (IaaS)

IaaS is also known as **Hardware as a Service (HaaS)**. It is a computing infrastructure managed over the internet. The main advantage of using IaaS is that it helps users to avoid the cost and complexity of purchasing and managing the physical servers.

Characteristics of IaaS

There are the following characteristics of IaaS -

- o Resources are available as a service
- o Services are highly scalable
- o Dynamic and flexible
- o GUI and API-based access
- o Automated administrative tasks

Example: DigitalOcean, Linode, Amazon Web Services (AWS), Microsoft Azure, Google Compute Engine (GCE), Rackspace, and Cisco Metacloud.

Platform as a Service (PaaS)

PaaS cloud computing platform is created for the programmer to develop, test, run, and manage the applications.

Characteristics of PaaS

There are the following characteristics of PaaS -

- o Accessible to various users via the same development application.
- o Integrates with web services and databases.
- o Builds on virtualization technology, so resources can easily be scaled up or down as per the organization's need.
- o Support multiple languages and frameworks.
- o Provides an ability to "**Auto-scale**".

Example: AWS Elastic Beanstalk, Windows Azure, Heroku, Force.com, Google App Engine, Apache Stratos, Magento Commerce Cloud, and OpenShift.

Software as a Service (SaaS)

SaaS is also known as **"on-demand software"**. It is a software in which the applications are hosted by a cloud service provider. Users can access these applications with the help of internet connection and web browser.

Characteristics of SaaS

There are the following characteristics of SaaS -

- o   Managed from a central location
- o   Hosted on a remote server
- o   Accessible over the internet
- o   Users are not responsible for hardware and software updates. Updates are applied automatically.
- o   The services are purchased on the pay-as-per-use basis

Example: BigCommerce, Google Apps, Salesforce, Dropbox, ZenDesk, Cisco WebEx, ZenDesk, Slack, and GoToMeeting.

Difference between IaaS, PaaS, and SaaS

The below table shows the difference between IaaS, PaaS, and SaaS -

IaaS	Paas	SaaS
It provides a virtual data center to store information and create platforms for app development, testing, and deployment.	It provides virtual platforms and tools to create, test, and deploy apps.	It provides web software and apps to complete business tasks.
It provides access to resources such as virtual machines, virtual storage, etc.	It provides runtime environments and deployment tools for applications.	It provides software as a service to the end-users.
It is used by network architects.	It is used by developers.	It is used by end users.
IaaS provides only Infrastructure.	PaaS provides Infrastructure+Platform.	SaaS provides Infrastructure+Platform +Software.

Infrastructure as a Service | IaaS

Iaas is also known as **Hardware as a Service (HaaS)**. It is one of the layers of the cloud computing platform. It allows customers to outsource their IT infrastructures such as servers, networking, processing, storage, virtual machines, and other resources. Customers access these resources on the Internet using a pay-as-per use model.

In traditional hosting services, IT infrastructure was rented out for a specific period of time, with pre-determined hardware configuration. The client paid for the configuration and time, regardless of the actual use. With the help of the IaaS cloud computing platform layer, clients can dynamically scale the configuration to meet changing requirements and are billed only for the services actually used.

IaaS cloud computing platform layer eliminates the need for every organization to maintain the IT infrastructure.

IaaS is offered in three models: public, private, and hybrid cloud. The private cloud implies that the infrastructure resides at the customer-premise. In the case of public cloud, it is located at the cloud computing platform vendor's data center, and the hybrid cloud is a combination of the two in which the customer selects the best of both public cloud or private cloud.

IaaS provider provides the following services -

1. **Compute:** Computing as a Service includes virtual central processing units and virtual main memory for the Vms that is provisioned to the end- users.
2. **Storage:** IaaS provider provides back-end storage for storing files.
3. **Network:** Network as a Service (NaaS) provides networking components such as routers, switches, and bridges for the Vms.
4. **Load balancers:** It provides load balancing capability at the infrastructure layer.

Advantages of IaaS cloud computing layer

There are the following advantages of IaaS computing layer -

1. Shared infrastructure

IaaS allows multiple users to share the same physical infrastructure.

2. Web access to the resources

Iaas allows IT users to access resources over the internet.

3. Pay-as-per-use model

IaaS providers provide services based on the pay-as-per-use basis. The users are required to pay for what they have used.

4. Focus on the core business

IaaS providers focus on the organization's core business rather than on IT infrastructure.

5. On-demand scalability

On-demand scalability is one of the biggest advantages of IaaS. Using IaaS, users do not worry about to upgrade software and troubleshoot the issues related to hardware components.

Disadvantages of IaaS cloud computing layer

1. Security

Security is one of the biggest issues in IaaS. Most of the IaaS providers are not able to provide 100% security.

2. Maintenance & Upgrade

Although IaaS service providers maintain the software, but they do not upgrade the software for some organizations.

3. Interoperability issues

It is difficult to migrate VM from one IaaS provider to the other, so the customers might face problem related to vendor lock-in.

Some important point about IaaS cloud computing layer

IaaS cloud computing platform cannot replace the traditional hosting method, but it provides more than that, and each resource which are used are predictable as per the usage.

IaaS cloud computing platform may not eliminate the need for an in-house IT department. It will be needed to monitor or control the IaaS setup. IT salary expenditure might not reduce significantly, but other IT expenses can be reduced.

Breakdowns at the IaaS cloud computing platform vendor's can bring your business to the halt stage. Assess the IaaS cloud computing platform vendor's stability and finances. Make sure that SLAs (i.e., Service Level Agreement) provide backups for data, hardware, network, and application failures. Image portability and third-party support is a plus point.

The IaaS cloud computing platform vendor can get access to your sensitive data. So, engage with credible companies or organizations. Study their security policies and precautions.

Top Iaas Providers who are providing IaaS cloud computing platform
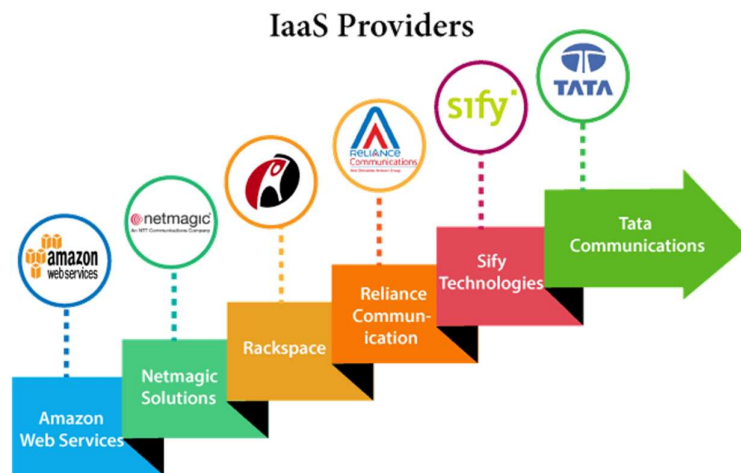
IaaS Vendor	Iaas Solution	Details
Amazon Web Services	Elastic, Elastic Compute Cloud (EC2) MapReduce, Route 53, Virtual Private Cloud, etc.	The cloud computing platform pioneer, Amazon offers auto scaling, cloud monitoring, and load balancing features as part of its portfolio.
Netmagic Solutions	Netmagic IaaS Cloud	Netmagic runs from data centers in Mumbai, Chennai, and Bangalore, and a virtual data center in the United States. Plans are underway to extend services to West Asia.
Rackspace	Cloud servers, cloud files, cloud sites, etc.	The cloud computing platform vendor focuses primarily on enterprise-level hosting services.

| Reliance Communications	Reliance Internet Data Center	RIDC supports both traditional hosting and cloud services, with data centers in Mumbai, Bangalore, Hyderabad, and Chennai. The cloud services offered by RIDC include IaaS and SaaS.
Sify Technologies	Sify IaaS	Sify's cloud computing platform is powered by HP's converged infrastructure. The vendor offers all three types of cloud services: IaaS, PaaS, and SaaS.
Tata Communications	InstaCompute	InstaCompute is Tata Communications' IaaS offering. InstaCompute data centers are located in Hyderabad and Singapore, with operations in both countries.

Platform as a Service | PaaS

Platform as a Service (PaaS) provides a runtime environment. It allows programmers to easily create, test, run, and deploy web applications. You can purchase these applications from a cloud service provider on a pay-as-per use basis and access them using the Internet connection. In PaaS, back end scalability is managed by the cloud service provider, so end-users do not need to worry about managing the infrastructure.

PaaS includes infrastructure (servers, storage, and networking) and platform (middleware, development tools, database management systems, business intelligence, and more) to support the web application life cycle.

Example: Google App Engine, Force.com, Joyent, Azure.

PaaS providers provide the Programming languages, Application frameworks, Databases, and
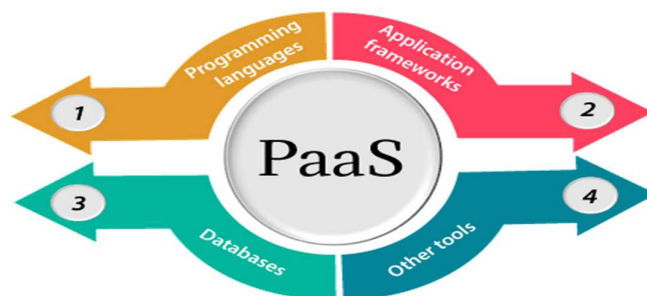
Other tools:

1. Programming languages

PaaS providers provide various programming languages for the developers to develop the applications. Some popular programming languages provided by PaaS providers are Java, PHP, Ruby, Perl, and Go.

2. Application frameworks

PaaS providers provide application frameworks to easily understand the application development. Some popular application frameworks provided by PaaS providers are Node.js, Drupal, Joomla, WordPress, Spring, Play, Rack, and Zend.

3. Databases

PaaS providers provide various databases such as ClearDB, PostgreSQL, MongoDB, and Redis to communicate with the applications.

4. Other tools

PaaS providers provide various other tools that are required to develop, test, and deploy the applications.

Advantages of PaaS

There are the following advantages of PaaS -

1) Simplified Development

PaaS allows developers to focus on development and innovation without worrying about infrastructure management.

2) Lower risk

No need for up-front investment in hardware and software. Developers only need a PC and an internet connection to start building applications.

3) Prebuilt business functionality

Some PaaS vendors also provide already defined business functionality so that users can avoid building everything from very scratch and hence can directly start the projects only.

4) Instant community

PaaS vendors frequently provide online communities where the developer can get the ideas to share experiences and seek advice from others.

5) Scalability

Applications deployed can scale from one to thousands of users without any changes to the applications.

Disadvantages of PaaS cloud computing layer

1) Vendor lock-in

the applications has to be written according to the platform provided by the PaaS vendor, so the migration of an application to another PaaS vendor would be a problem.

2) Data Privacy

Corporate data, whether it can be critical or not, will be private, so if it is not located within the walls of the company, there can be a risk in terms of privacy of data.

3) Integration with the rest of the systems applications

It may happen that some applications are local, and some are in the cloud. So there will be chances of increased complexity when we want to use data which in the cloud with the local data.

Popular PaaS Providers
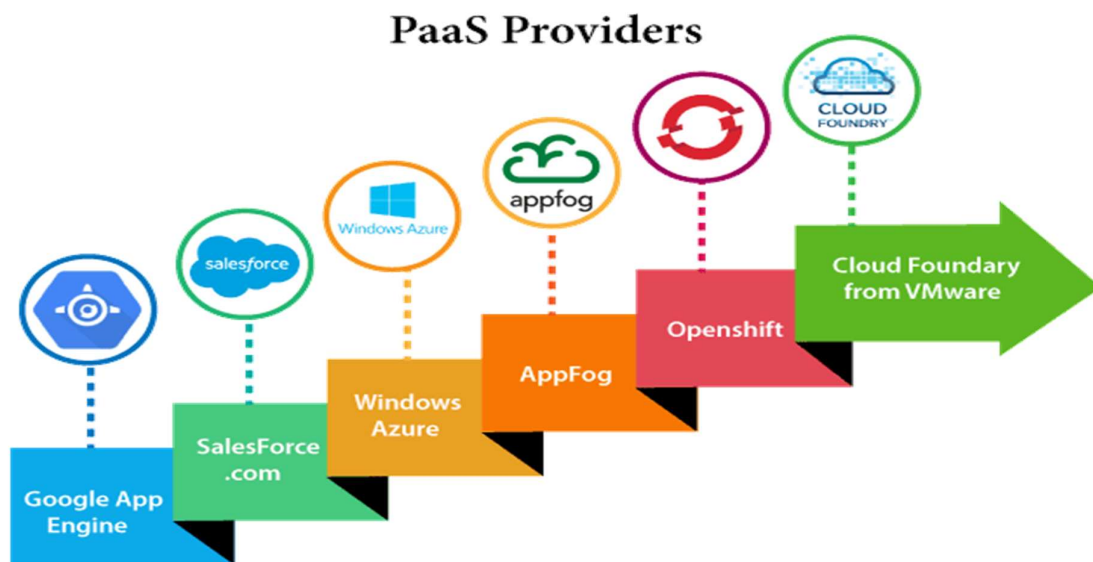
The below table shows some popular PaaS providers and services that are provided by them -

Providers	Services
Google App Engine (GAE)	App Identity, URL Fetch, Cloud storage client library, Logservice

Salesforce.com	Faster implementation, Rapid scalability, CRM Services, Sales cloud, Mobile connectivity, Chatter.
Windows Azure	Compute, security, IoT, Data Storage.
AppFog	Justcloud.com, SkyDrive, GoogleDocs
Openshift	RedHat, Microsoft Azure.
Cloud Foundry from VMware	Data, Messaging, and other services.

Software as a Service | SaaS

SaaS is also known as **"On-Demand Software"**. It is a software distribution model in which services are hosted by a cloud service provider. These services are available to end-users over the internet so, the end-users do not need to install any software on their devices to access these services.

There are the following services provided by SaaS providers -

Business Services - SaaS Provider provides various business services to start-up the business. The SaaS business services include **ERP** (Enterprise Resource Planning), **CRM** (Customer Relationship Management), **billing**, and **sales**.

Document Management - SaaS document management is a software application offered by a third party (SaaS providers) to create, manage, and track electronic documents.

Example: Slack, Samepage, Box, and Zoho Forms.

Social Networks - As we all know, social networking sites are used by the general public, so social networking service providers use SaaS for their convenience and handle the general public's information.

Mail Services - To handle the unpredictable number of users and load on e-mail services, many e-mail providers offering their services using SaaS.

Advantages of SaaS cloud computing layer

1) SaaS is easy to buy

SaaS pricing is based on a monthly fee or annual fee subscription, so it allows organizations to access business functionality at a low cost, which is less than licensed applications.

Unlike traditional software, which is sold as a licensed based with an up-front cost (and often an optional ongoing support fee), SaaS providers are generally pricing the applications using a subscription fee, most commonly a monthly or annually fee.

2. One to Many

SaaS services are offered as a one-to-many model means a single instance of the application is shared by multiple users.

3. Less hardware required for SaaS

The software is hosted remotely, so organizations do not need to invest in additional hardware.

4. Low maintenance required for SaaS

Software as a service removes the need for installation, set-up, and daily maintenance for the organizations. The initial set-up cost for SaaS is typically less than the enterprise software. SaaS vendors are pricing their applications based on some usage parameters, such as several users using the application. So SaaS does easy to monitor and automatic updates.

5. No special software or hardware versions required

All users will have the same version of the software and typically access it through the web browser. SaaS reduces IT support costs by outsourcing hardware and software maintenance and support to the IaaS provider.

6. Multidevice support

SaaS services can be accessed from any device such as desktops, laptops, tablets, phones, and thin clients.

7. API Integration

SaaS services easily integrate with other software or services through standard APIs.

8. No client-side installation

SaaS services are accessed directly from the service provider using the internet connection, so do not need to require any software installation.

Disadvantages of SaaS cloud computing layer

1) Security

Actually, data is stored in the cloud, so security may be an issue for some users. However, cloud computing is not more secure than in-house deployment.

2) Latency issue

Since data and applications are stored in the cloud at a variable distance from the end-user, there is a possibility that there may be greater latency when interacting with the application compared to local deployment. Therefore, the SaaS model is not suitable for applications whose demand response time is in milliseconds.

3) Total Dependency on Internet

Without an internet connection, most SaaS applications are not usable.

4) Switching between SaaS vendors is difficult

Switching SaaS vendors involves the difficult and slow task of transferring the very large data files over the internet and then converting and importing them into another SaaS also.

Popular SaaS Providers

The below table shows some popular SaaS providers and services that are provided by them -

Provider	Services
Salseforce.com	On-demand CRM solutions
Microsoft Office 365	Online office suite
Google Apps	Gmail, Google Calendar, Docs, and sites
NetSuite	ERP, accounting, order management, CRM, Professionals Services Automation (PSA), and e-commerce applications.
GoToMeeting	Online meeting and video-conferencing software
Constant Contact	E-mail marketing, online survey, and event marketing
Oracle CRM	CRM applications
Workday, Inc	Human capital management, payroll, and financial management.

What is Cloud Deployment?

A cloud deployment is an installation of hardware and software that is accessible over the internet on a specialized platform. We can think of Software as a Service (SaaS), Platform as a Service (PaaS), Infrastructure as a Service (IaaS), and other solutions as being good examples of this. Each of these different solutions are offered to end users, businesses, and other providers so that they can perform specific tasks.

Types of Cloud Computing Deployment Models
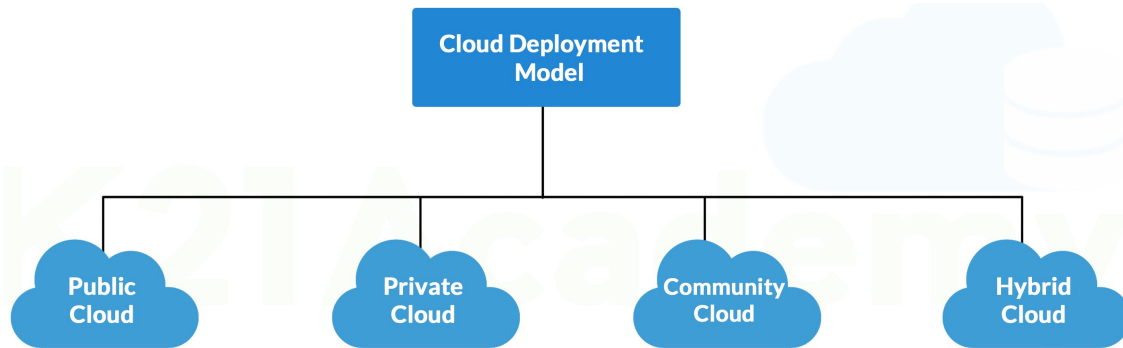
Using cloud deployment models benefits various companies in many ways, such as boosting productivity and providing a competitive advantage. There are **mainly four Cloud Deployment Models** available. You may ask a question why do we have these many cloud deployment models present? What is the use of them? Well, let's find out below:

Public Cloud Deployment Model

As the name indicates, the public cloud is available for the general public who want to use computing resources such as software and hardware over the internet. It is a **good choice** for companies and organizations **with low-security concerns**. There is no need to manage these resources as cloud computing providers configure and manage these services. Generally, public clouds are used for application development and testing.
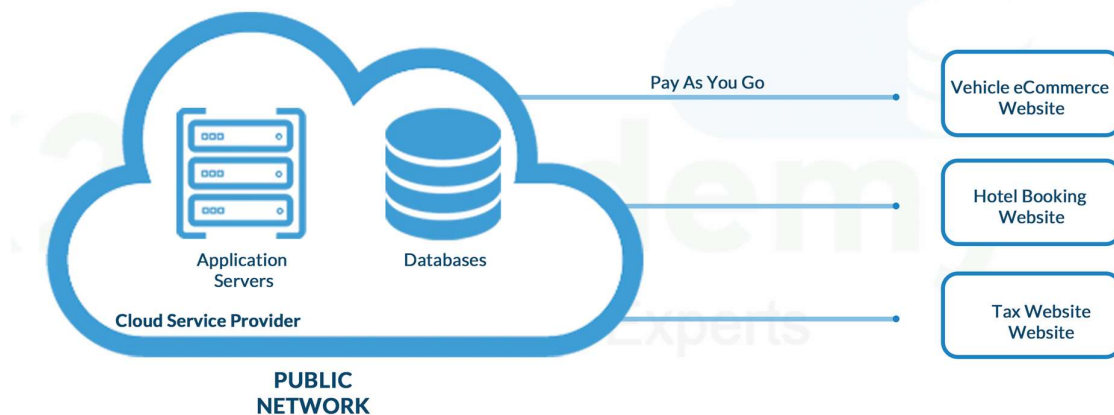
Examples of top Public Cloud Deployment model Providers:

- Amazon EC2
- Google App Engine
- Microsoft Azure
- IBM Cloud

Benefits of Public Cloud Deployments

- **Easy to manage.** The great thing about having a managed service is that there is very little for you and your team to do on the maintenance front. The setup is taken care of and there is no need to develop your own tools as this is also accounted for.
- **Cost.** The way services are billed means that you don't pay for items that you don't use. You can pay more when you need more resources, and then scale back when that levels out again.
- **Performance and reliability.** Up time is the main concern that most businesses have. If your systems are down then your business suffers. Many of these cloud providers offer exceptional up time and service availability.

Disadvantages of Public Cloud Deployments

- **Less control.** You are not in control of the systems that host your business applications. In the unlikely event that a public cloud platform fails, you do not have access to ensure continuity as would be the case with a traditional server room or data center environment.
- **Privacy and security.** Segmentation needs to be carried out to the highest standard to ensure that there is no cross contamination between clients that are using the same hardware on a public cloud.
- **Simple Environments.** Most organizations have specific requirements for tailor-made services. Many cloud platforms offer only simple functionality with little to no customization opportunities.

Private Cloud Deployment Model
As the name suggests, Private Cloud lets you use the **infrastructure** and **resources for a single organization**. Users and organizations do not share resources with other users. That is why it is also called as **Internal or corporate model**. Private clouds are more costly than public clouds due to their costly maintenance.
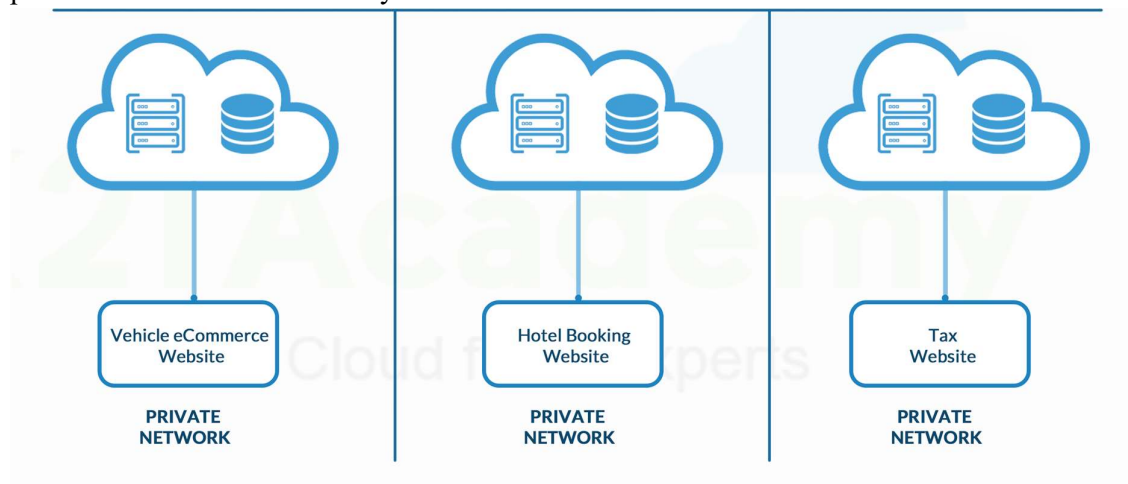
Examples of top Private Cloud Deployment model Providers:

- Amazon Web Services
- Microsoft Azure
- Google Cloud Platform
- Dell
- Cisco

Benefits of Private Cloud Deployments

- **Increased control.** Less people will have access to the administration and configuration of the back end infrastructure that powers your private cloud, which gives you more control.
- **Customization.** If there is a business case for a new feature, you can have it developed and deployed in house, giving you more options than a publicly available cloud.
- **Highly secure.** You can incorporate as many security services as you want in order to secure your cloud. Two-Factor Authentication is far more secure when combined with security best practices such as complex passwords and mandatory password changes.

Disadvantages of Private Cloud Deployments

- **Learning curve.** To take advantage of being able to customize your private cloud, you need the right technical skills. Developers, cyber security experts, and DevOps professionals are all roles that you need to fill in order to effectively develop a solution on your private cloud.
- **Cost.** All but the largest companies in the world can afford to set up their own private cloud infrastructure. The hardware costs alone are prohibitively expensive for most companies. There's also the costs of keeping skilled staff and other infrastructure costs. This is a cloud deployment method that is aimed at large organizations and not SMBs.
- **Community Cloud Deployment Model**
- The community Deployment Model is somewhat similar to the Private cloud. In the private cloud, only one user or organization owns the cloud server. In Community Cloud, **several companies with the same backgrounds share the cloud server**. If all organizations or companies have the same set of security protocols and performance requirements, and goals, this multi-tenant architecture can help them save cost and boost efficiency. This model can be used in the case of project development, implementation, and maintenance.

Community Cloud   **All Other Services**
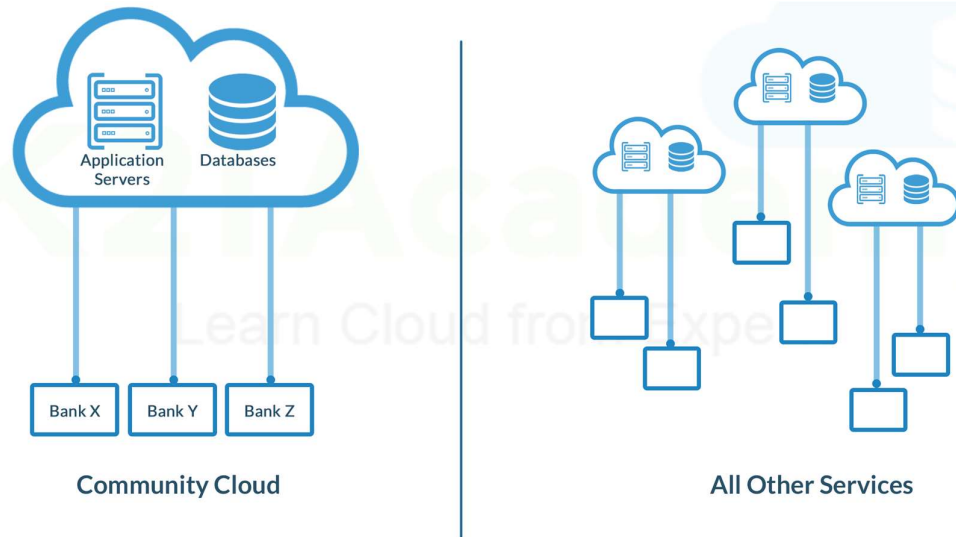
Benefits of Community Cloud Deployments

- **Cost Savings.** As we touched on before, the main benefit of using this kind of setup is that there are cost savings. This is because all of the users that access the community cloud will share the costs to create an equitable experience.
- **Security between tenants.** If the security policies are aligned and if everyone follows the same standards then the community cloud model is very secure.
- **Enhanced collaboration.** When there is a shared goal then having everyone on the same platform creates more opportunities to work together towards the same objectives.

Disadvantages of Community Cloud Deployments

- **Technical requirements.** A community cloud has to agree upon a set of standards and then coordinate across that cloud. This means that each stakeholder must have their own technical resources available to enforce the policies.
- **Data isolation.** Security and segmentation is difficult to maintain.
- **Rarity.** This model is not widely used, yet, so there are not too many resources available for people to learn from or well known examples.

    Hybrid Cloud Deployment Model
- The Hybrid Cloud is a **combination of both public and private clouds**. Very few companies and organizations can migrate their tech stack to cloud computing rapidly in one go. Hence, Cloud vendors came up with a hybrid cloud that offers a smooth

transition with public and private cloud facilities. They keep the sensitive data in the private cloud and non-sensitive data in the public cloud.
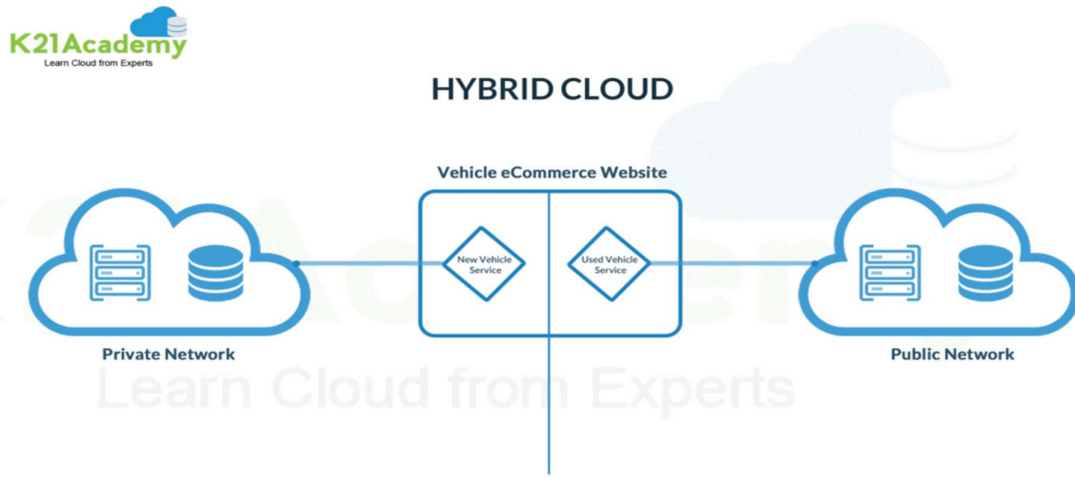
Benefits of Hybrid Cloud Deployments

- **Flexibility.** One of the best features of this cloud type is that it is very flexible. You can pick the best parts of each cloud type and integrate it into your solution.
- **Scalability.** You are not limited to any one platform, or its limitations. This means that you can scale with the demand of your users.

Disadvantages of Hybrid Cloud Deployments

- **Cost.** If you are using a hybrid cloud, you can fall into the trap of spending too much. Hybrid clouds are not inherently more expensive than any of the other types that we have looked at. But there is certainly a risk of spending too much if you are not careful about selecting the right services.
- **Data silos.** If you are using a combination of public and private services, you have to make sure that all of your data has been properly separated. This can increase the security, compliance, and auditing requirements of your business.

Cloud Computing Providers: AWS, Azure, Google Cloud, and Others

A cloud service provider, or CSP, is an IT company that provides on-demand, scalable computing resources like computing power, data storage, or applications over the internet. Typically, cloud-based service models are defined as IaaS (infrastructure as a service), PaaS (platform as a service), or SaaS (software as a service).

Amazon Web Services (AWS

• Amazon Web Services (AWS) provides computing resources and services that you can use to build applications within minutes at pay-as-you-go pricing.

• For example, you can rent a server on AWS that you can connect to, configure, secure, and run just as you would a physical server.

• The difference is the virtual server runs on top of a planet-scale network managed by AWS.

• Using AWS to build your Internet application is like purchasing electricity from a power company instead of running your own generator

Dominance: AWS currently dominates the cloud infrastructure market, offering a wide range of services including scalable storage, networking, server hosting, mobile development, and cybersecurity solutions.

Scalability: Known for its scalability and extensive service offerings.

Market Share: Holds a significant share in the cloud market.

Compute Options: Provides various compute options, including EC2 (Elastic Compute Cloud) for virtual servers.

Pricing: Offers a pay-as-you-go model, allowing businesses to scale resources efficiently.

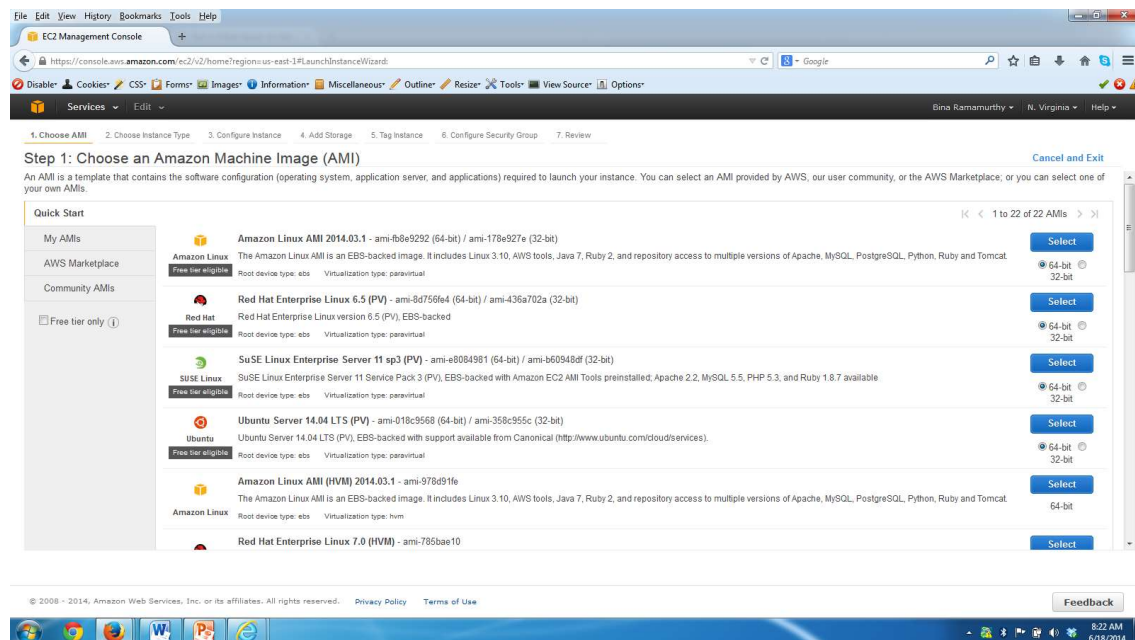Specialization: Strong in infrastructure services.
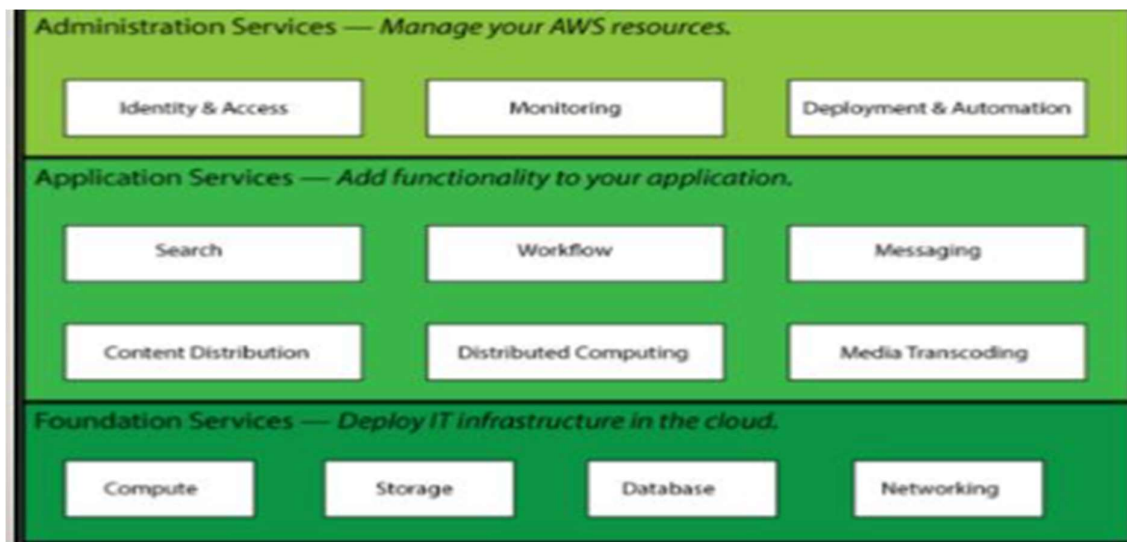
What can you do with aws?

You can run nearly anything on AWS that you would run on physical hardware: websites, applications, databases, mobile apps, email campaigns, distributed data analysis, media storage, and private networks.

Amazon console
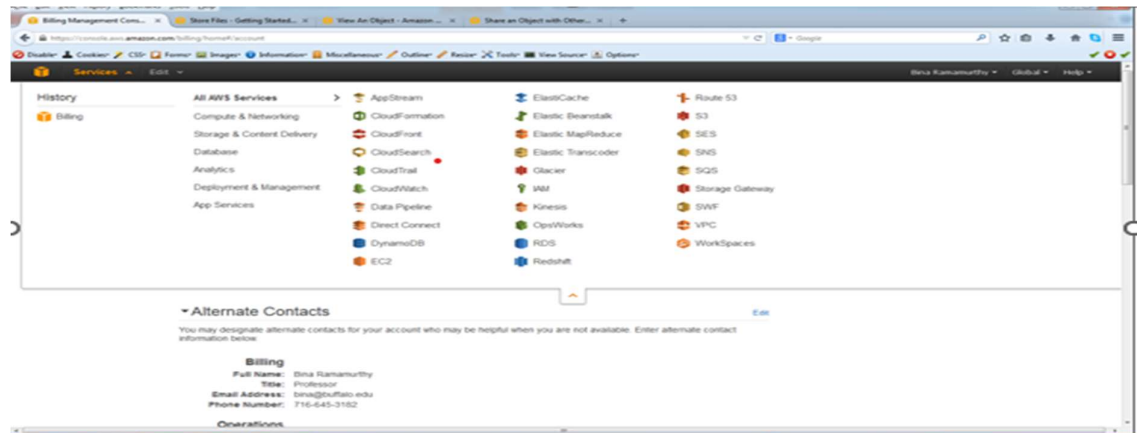
Amazon Machine Images (AMI)

Microsoft azure:

- Scalable Software Solutions: Azure is a chief rival to AWS, providing scalable and efficient software solutions.

- Hybrid Cloud: Known for its hybrid cloud capabilities, seamlessly integrating on-premises and cloud environments.

- Enterprise Integration: Popular among enterprises due to its integration with Microsoft products.

- Compute Options: Offers services like Azure Virtual Machines.

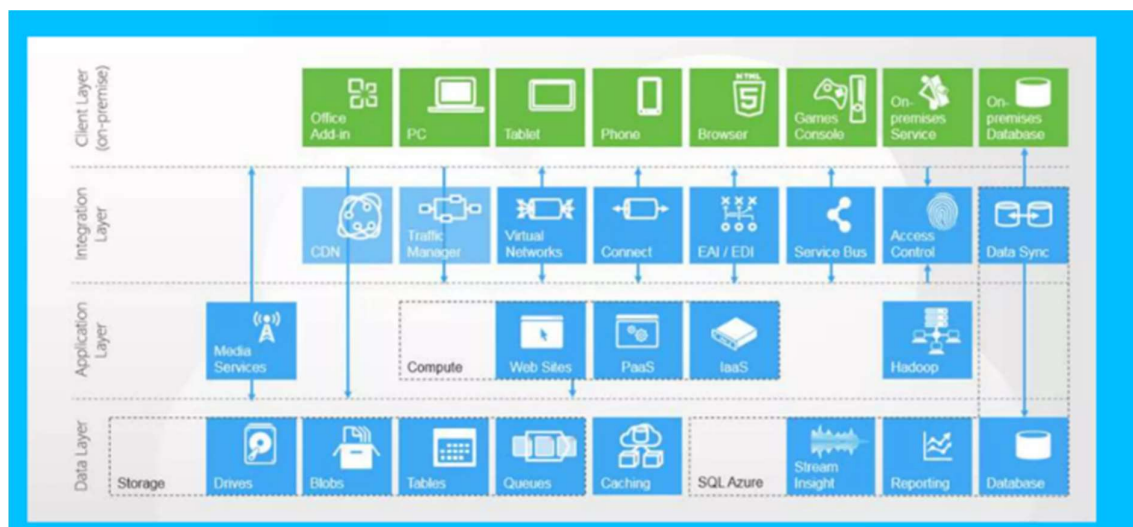- Managed Services: Provides managed services for various workloads.

- AI and Analytics: Strong focus on artificial intelligence (AI) and analytics.
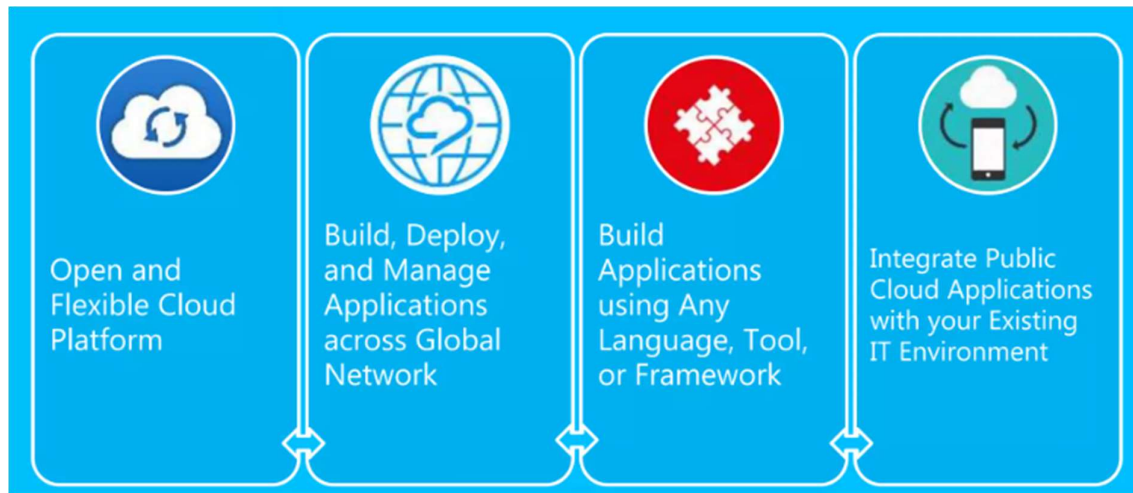
Azure service:
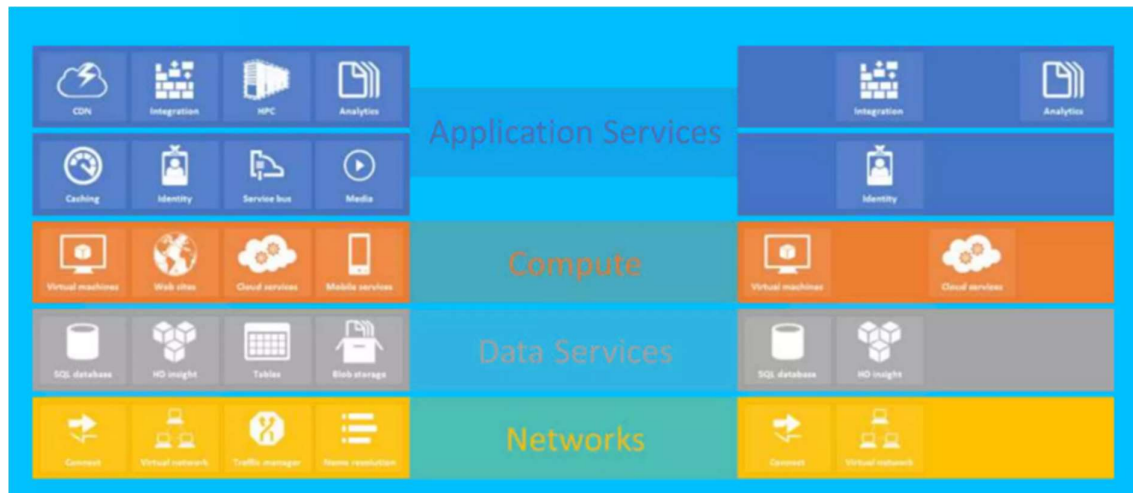
Azure components:

Google Cloud Platform

Google Cloud Platform, is a suite of cloud computing services and management tools offered by Google Alongside a set of management tools, it provides a series of modular cloud services including computing, data storage, data analytics and machine learning Google Cloud Architect Certification Training

Google cloud provider

Big Data Analytics: GCP excels in high-end big data analytics solutions.

Interoperability: Allows easy interaction with other vendor products.

Compute Options: Offers services like Google Compute Engine.

Machine Learning: Known for its machine learning and AI capabilities.
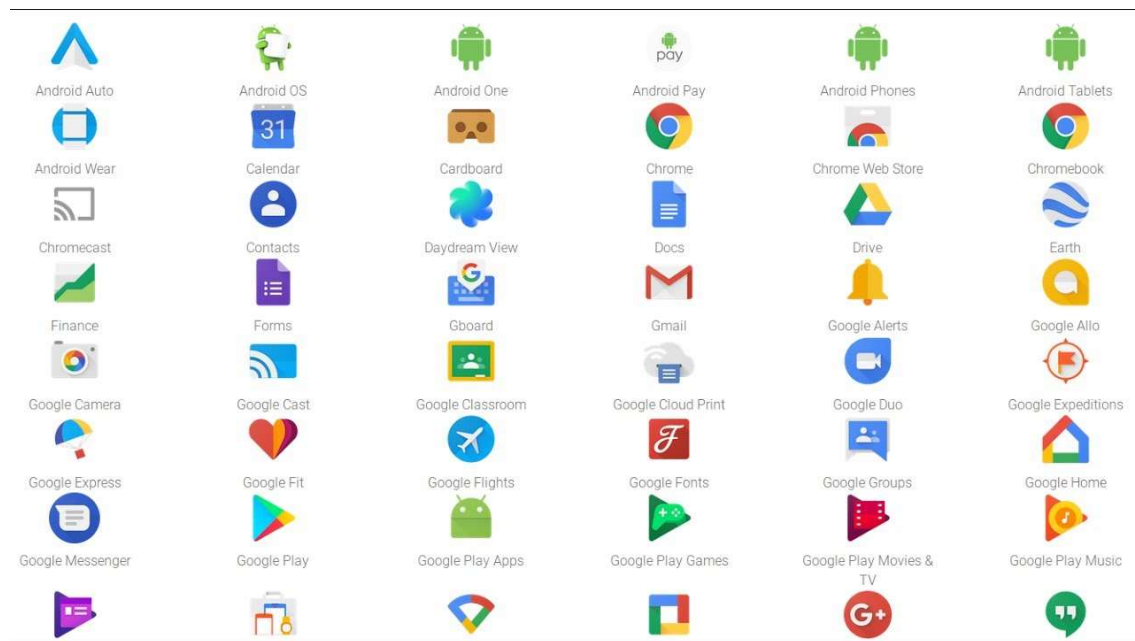
Innovation: Emphasizes innovation and developer-friendly tools.

Specialization: Strong in data-related services.

Google cloud platform

GCP is a suite of cloud computing services that runs on the same infrastructure that Google uses internally forits end user products, such as Gmail,Google Photos,Google Search,etc.,
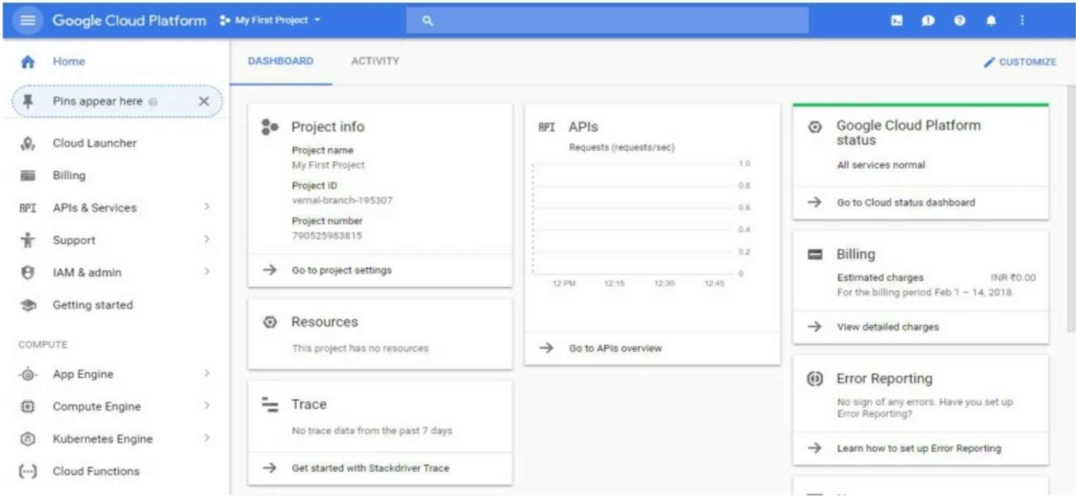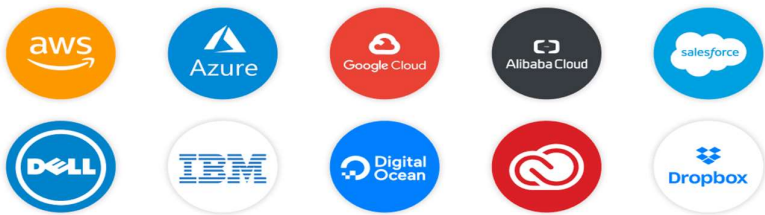

Google Cloud platform:

Gcp regions and zones:

Gcp home:

Top 10 Cloud Providers

Mapping the world's cloud projects

Data based on 7,000 public customer case studies on respective cloud vendor websites

	aws	Microsoft	Google	ORACLE	Alibaba Cloud
No. of case studies	2,554	2,117	1,522	505	276
By industry[1]	❶ ICT 40% ❷ Mfg. 14% ❸ Fin. 12% ❹ Retail 6%	❶ Mfg. 24% ❷ ICT 17% ❸ Fin. 12% ❹ Edu. 8%	❶ ICT 43% ❷ Fin. 14% ❸ Mfg. 10% ❹ Retail 7%	❶ ICT 36% ❷ Mfg. 16% ❸ Fin. 11% ❹ Gov. 7%	❶ ICT 43% ❷ Fin. 19% ❸ Retail 19% ❹ Edu. 5%
By region[2]	NA 47% EMEA 25% APAC 26% SA 2%	NA 27% EMEA 44% APAC 24% SA 5%	NA 26% EMEA 38% APAC 28% SA 9%	NA 29% EMEA 24% APAC 30% SA 15%	NA 5% EMEA 8% APAC 87% SA 0%
By customer size[3]	XL 23% L 23% M 38% S 16%	XL 33% L 33% M 26% S 8%	XL 15% L 18% M 43% S 25%	XL 21% L 24% M 34% S 20%	XL 11% L 15% M 45% S 29%
Key customers[4]	NETFLIX Coca-Cola salesforce NIKE JP MORGAN CHASE & CO.	Schneider Electric PayPal BOSCH P&G T Mobile	ASML Revolut sky Barilla	cognizant FedEx Canon xerox Capgemini	CASIO SHISEIDO tech Ford airasia