

Cloud Computing

(Elective – III)

Subject Code - CSE607

6Th Semester

NOTES

for

Diploma

In

Computer Science Engineering



Subject : Cloud Computing (Elective – III)

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Cloud

Computing

Topics

Module 1:

Introduction- Shift from distributed computing to cloud computing; principles and characteristics of cloud computing- IaaS, PaaS, SaaS; service-oriented computing and cloud environment

8 Hrs

Module 2:

Cloud Computing Technology-Client systems, Networks, server systems and security from services perspectives; Accessing the cloud with platforms and applications; cloud storage

9 Hrs

Module 3:

Working with Cloud -Infrastructure as a Service – conceptual model and working Platform as a Service – conceptual model and functionalities. Software as a Service – conceptual model and working. Trends in Service provisioning with clouds

10 Hrs

Module 4:

Using Cloud Services-Cloud collaborative applications and services – case studies with calendars, schedulers and event management; cloud applications in project management.

9 Hrs

Module 5:

Case studies- Microsoft Azure, Google App Engine and Open-source clouds- Open Nebula and Eucalyptus

6 Hrs

Module 1

Introduction to Cloud Computing

Cloud computing is a way of accessing compute and storage systems without actually owning and doing active management of the resources. In today's world compute and storage demands are very dynamic hence purchasing, maintaining and upgrading systems could be a huge investment of time and money. Companies like AWS (Amazon Web Services), Microsoft Azure, Google Cloud Platform (GCP) provide compute and storage servers on demand and charge for what you use. These cloud services can be used to host static website, e-commerce store, company's internal data, etc. It has proven to be extremely useful for start-ups where compute resources can vary largely over time.

Cloud Computing can be classified in terms of the following models:

1. Service Models
2. Deployment Models

1. Service Models

After learning about the Introduction to Cloud Computing, now we are studying about the Service models which are classified in terms of abstraction provided to the end user.



SaaS (Software as a Service)

In the SaaS-based model all the compute and storage needs are met by the cloud service provider, the user only needs to upload and download data. Maintenance, downtime, upgradation, security are all taken care of by the service provider.

PaaS (Platform as a Service)

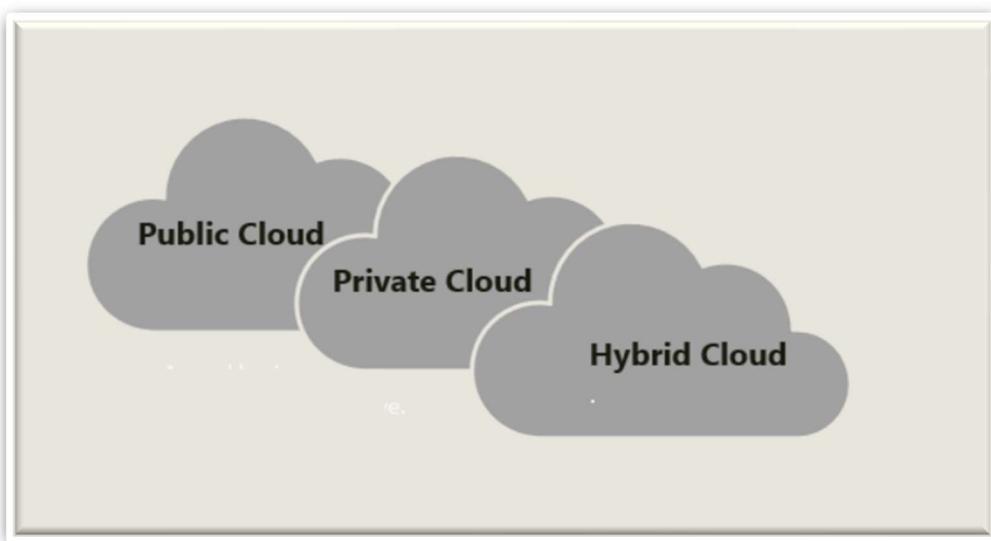
In PaaS user manages applications along with data. Lot of times the user wants to launch and maintain their own applications over the cloud which is where PaaS comes into the picture. All the Hardware, Networking, O/S needs are met by the service provider. The user can use any programming language of choice. PaaS services are cheaper compared to SaaS.

IaaS (Infrastructure as a Service)

In IaaS based service hardware, Virtualization and networking services are provided by the vendor while the user takes care of OS, applications, and data.

2. Deployment Models

In the above section, we have already learned about the introduction to cloud computing and about service model, now we are going to know about the three kinds of Deployment models: Public Cloud, Private Cloud, and Hybrid Cloud



1. Public Cloud

- Service Provider makes resources such as Compute, storage, and applications available to the general public over the internet.
- Any user can log in and use these services.
- You pay for the number of resources you use.
- Users have lesser control over their data.

2. Private Cloud

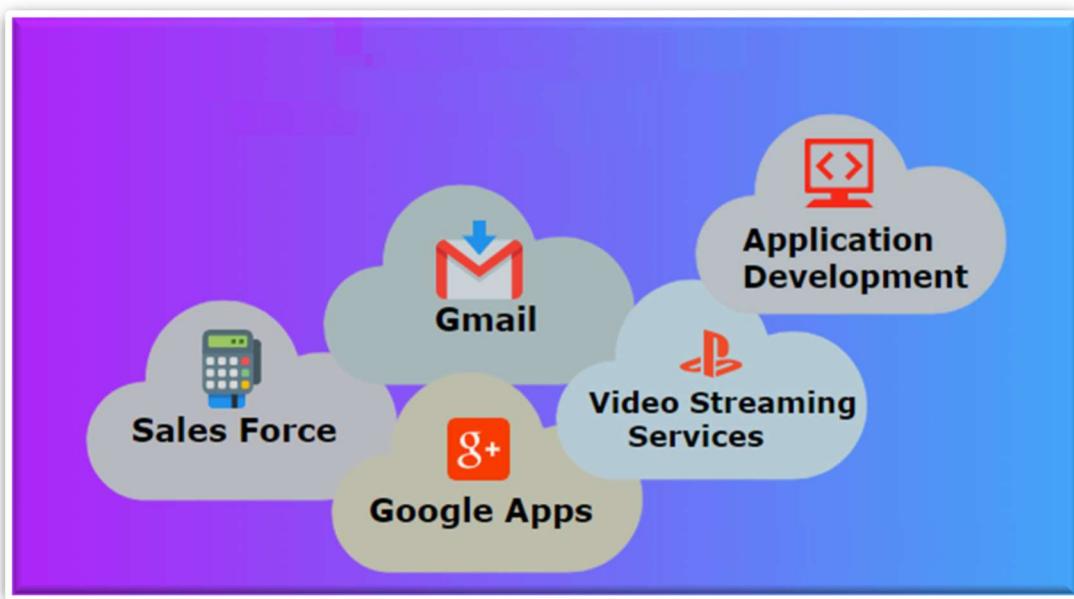
- The vendor offers hosted services to fewer users with firewall security.
- Private cloud minimizes security issues.
- It provides greater control over the data.
- Typically used by organizations with a focus on data security.

3. Hybrid Cloud

- Hybrid cloud computing as the name implies uses a combination of private and public cloud services. Certain services are hosted with private cloud while others with the public cloud.
- With hybrid cloud service, enterprises can keep crucial data into private space and other data into public space thus leveraging the best of both worlds.

Applications of Cloud Computing

As we studied the Introduction to Cloud computing to know more about Cloud computing Let's have a look at the applications of Cloud computing:



Sales Force: Sales Force provides CRM (Customer Relationship Management) services and EPR (Enterprise Resource Planning) on cloud infrastructure and charges on use basis. The software is developed and maintained by Salesforce and it also provides add on services for premium users.

Gmail: We know Gmail use for personal emails. But Gmail also provides its infrastructure to businesses with their business email-id with additional features.

Google Apps: Applications like Google Sheets, Google Drive allow cloud storage and computing for the general public.

Video Streaming Services: Several Video streaming services such as NetFlix, Amazon Prime, Hotstar rely on cloud computing storage to stream personalized data to billions of users simultaneously.

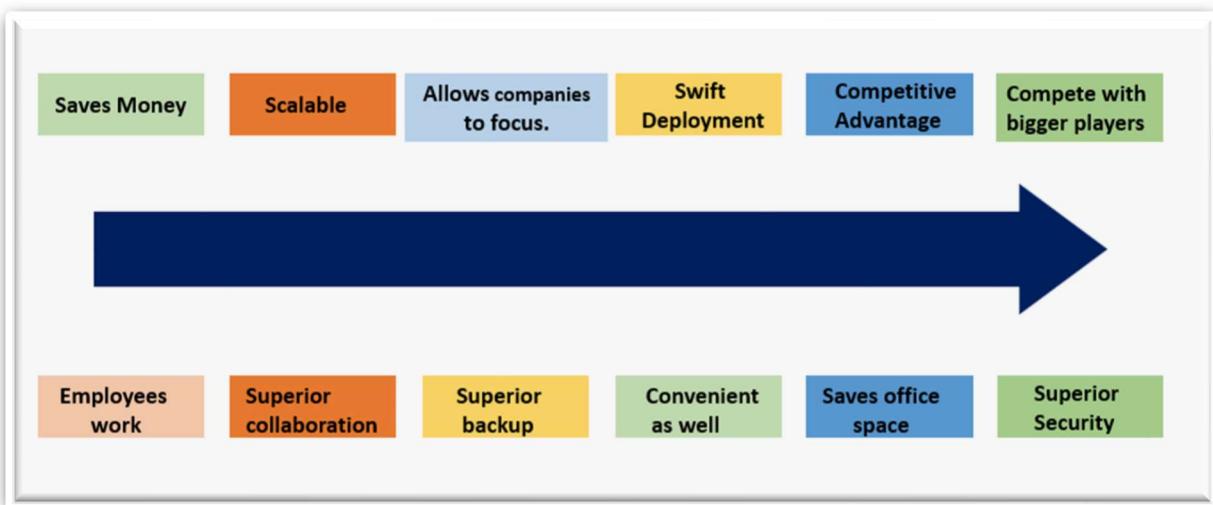
Application Development: With more and more companies providing their services via Mobile Apps, companies like Zoho Apps allow users to create apps over the cloud and make modifications. Wix and WordPress provide the same service for website creation and hosting.

Advantages & Disadvantages of Cloud Computing

The term ‘Cloud Computing’ is very much in vogue nowadays. In the Advantages and Disadvantages of cloud computing instead of storing data, applications, and software on in-premises hardware, they are stored on remote servers. Subscribers use the internet to access data, applications, and software from the remote servers and they are charged a fee for that. Users can access data, run applications/software from the remote server. The on-premises hardware is not needed. Computing services are provided by remote entities such as databases, software, analytics as well as intelligence. The remote hardware is referred to as the cloud. Its use is widespread as well as offers many benefits.

Advantages of Cloud Computing

Following are the advantages of Cloud Computing.



1. Saves Money

You do not have to buy software and hardware. They are provided by the cloud. Hence you save costs such as office space rent, electricity, air conditioning, maintenance as well as operational expenses. Also, you pay only for the services that you use. Earlier there used to be unused hardware and software for organizations using on-premises hardware and software. Cloud eliminates that aspect of the business.

2. Scalable

You can change the resources you need from the cloud up or down. This was not possible earlier. Companies had to buy additional resources when requirements increased. When requirements reduced, they were left with unwanted resources.

3. Allows companies to focus on their core areas of business

Earlier, businesses had to allocate human resources, time, money, and effort to manage in-premises hardware. Cloud takes care of all the hardware and software aspects of businesses. This allows the business to concentrate on taking care of their domain areas.

4. Swift Deployment

Thanks to the cloud your business system can be up and running in just a few minutes. This gives an early lead over companies using the traditional or conventional approach.

5. Competitive Advantage

Businesses leveraging the cloud has a strategic edge over those that don't. This is because they can start off quickly and have the latest hardware as well as software services.

6. Compete with bigger players

Cloud creates a level playing field. Even small companies can afford it. They don't have to spend a huge amount initially to start operating. The cloud subscription cost is much less than outright purchasing the new and latest hardware as well as software.

7. Employees can work from any place at any time

Cloud services are available round the clock. Even if the office is closed work can go on. You can work at any time and from any geographical location as long as you have an Internet-enabled device.

8. Superior collaboration

Thanks to the cloud technology company staff stationed in different places can collaborate conveniently while maintaining high levels of security.

9. Superior backup

Compared to on-premise technology where backup, as well as recovery, takes a lot of time you can easily and conveniently do backup and recovery on the cloud platform. There is less downtime involving cloud-based platforms. The latter provides quicker as well as relatively more accurate retrievals of information as well as applications.

10. Convenient as well as easy implementation

Cloud technology lets companies retain the same business processes while not having to handle the backend technicalities.

11. Saves office space

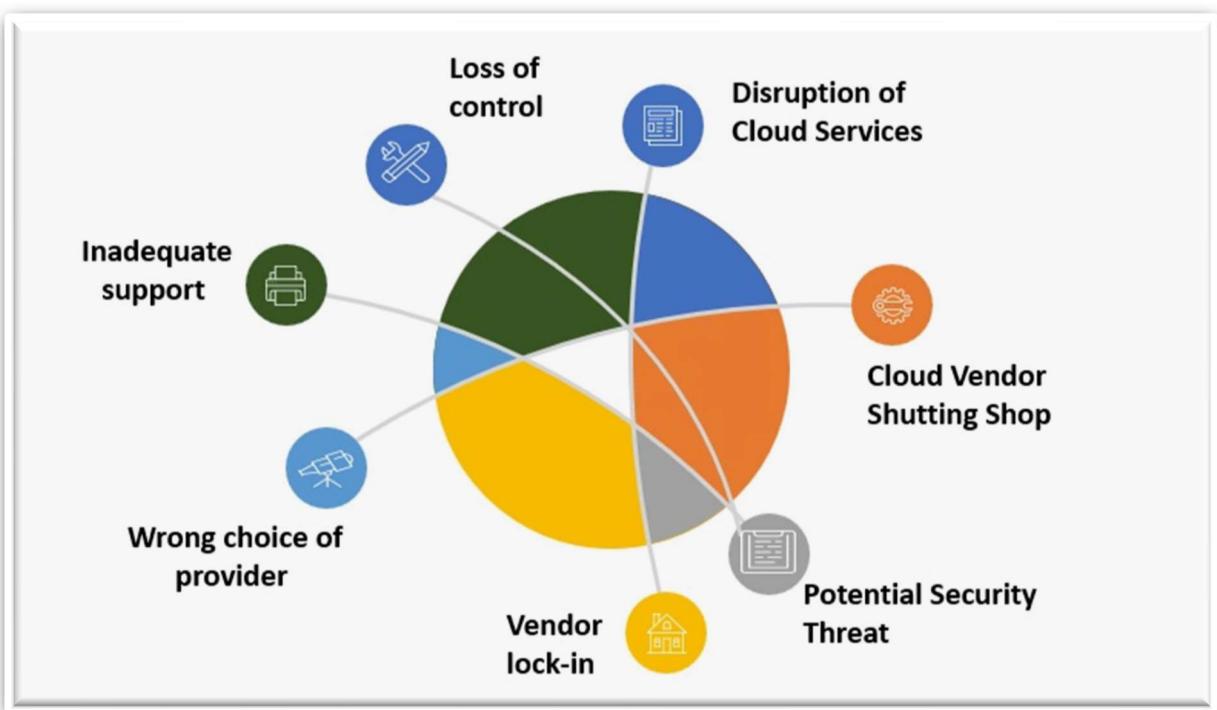
Since there is minimum hardware installed at the company premises and fewer people required to manage and administer the hardware and software considerable office space is saved. This is an important benefit given the current trend of costly commercial real estate rates.

12. Superior Security

The cloud host completely handles the important responsibility of security. You don't have to worry about or handle security. The cloud host installs the latest security hardware and software. He/she also regularly update the security services, applies security patches and reviews the security level.

Disadvantages of Cloud Computing

Following are the disadvantages of Cloud Computing.



1. Loss of control

By opting for cloud services, you are handing over your data as well as applications. You are dependent on the cloud provider in case any hardware or software issues manifest themselves. The speed and quality of service in such situations may not match your expectations.

2. Disruption of Cloud Services

In case of a cyber-attack, power outage or loss of Internet connectivity at the Cloud provider's end your business can suffer from unwanted downtime.

3. Cloud Vendor Shutting Shop

There is the possibility of your cloud service provider going out of business or changing its business domain. Your business will stop operating in this eventuality. You will have to quickly find another cloud service provider who is competent as well as reliable.

4. Potential Security Threat

Hackers are currently targeting high profile websites such as that of prominent cloud service providers. You have no control over the security of your data, applications, and software. Also, you can suffer losses and downtime if your cloud service provider's security is breached.

5. Vendor lock-in

In the event of migration to another cloud platform from the current platform, you may encounter major issues as the two platforms may be quite different. The challenges may include lack of support, configuration issues as well as an extra cost.

6. Wrong choice of provider

If you have not done your homework well or asked for reliable references while selecting a suitable cloud services provider then you may be in trouble. The quality of service may not be as desirable or certain features of cloud services may not be offered. This can affect the whole or part functioning of your business or operations.

7. Inadequate support

Some cloud computing providers fail to provide adequate support to their clients. Also, they ask you to refer FAQs for technical problems which are a difficult task for non-technical persons.

Cloud Service Providers

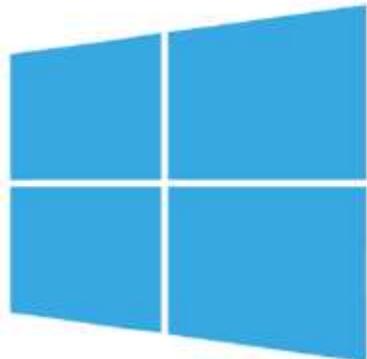
Amazon Web Service (AWS)

- AWS is the safest and protected platform of cloud service which offers a wide set of infrastructure services like database storage, computing power, networking.
- Using this AWS one can host the static websites.
- By using such services, users are able to build complicated applications that are trustworthy, scalable and flexible.
- One can have the hands-on experience of AWS for free.



Microsoft Azure

- Microsoft Azure is used for deploying, designing and managing applications through a worldwide network.
- Previously Microsoft Azure was known as Windows Azure.
- This Cloud computing service supports various operating systems, databases, tools, programming languages, and frameworks.
- A free trial version of Microsoft Azure is available for 30 days.



Google Cloud Platform

- Google Cloud Platform uses resources such as computers, virtual machines, hard disks, etc. located at Google data centres.
- Google Cloud Platform is an integrated storage used by developers and enterprises for live data.
- Apart from the free trial, this service is available at various flexible payment plans based on Pay-As-You-Go (PAYG).



Google Cloud

Adobe

- Adobe offers many products that provide cloud services. Few among them are Adobe Creative Cloud, Adobe Experience Cloud, and Adobe Document Cloud.
- Adobe Creative Cloud service is a SaaS, that offers its users to access the tools offered by Adobe like editing the videos, photography, graphic designing.
- Adobe Experience Cloud offers its users to access a broad set of solutions for advertising, building campaigns and gaining intelligence on business.
- Adobe Document Cloud is a complete solution for digital documentation.



Adobe

IBM Cloud

- IBM Cloud offers IaaS, PaaS, and SaaS through all the available cloud delivery models.
- Using IBM Cloud one can have the freedom to select and unite your desired tools, data models and delivery models in designing/creating your next-generation services or applications.
- IBM Cloud is used to build pioneering way outs that can gain value for your businesses and industry.
- With the IBM Bluemix Cloud platform, one can incorporate highly performing cloud communications and services into your IT environment.



Oracle Cloud

- Oracle Cloud is available as SaaS, PaaS, and IaaS. Oracle Cloud helps the companies in transforming their business quickness and reducing the IT Complexity.
- Oracle Cloud SaaS provides a complete data-driven and secure cloud environment.
- Oracle Cloud PaaS helps IT Enterprises and Independent developers to develop, connect, secure and share data across the applications.
- Oracle Cloud IaaS is a broad set of subscription-based and integrated services that help to run any kind of workload of an Enterprise.



Salesforce

- Salesforce Cloud Computing offers all the applications required by businesses like CRM, ERP, customer service, sales, mobile applications, and marketing.
- Salesforce cloud computing comprises multiple cloud services like Sales Cloud, Service Cloud, Marketing Cloud.
- Salesforce Sales Cloud helps in managing the customer's contact information and automating the business processes.
- Salesforce Service Cloud helps to support customers anywhere at any time.



Verizon Cloud

- Verizon Cloud is built to maintain enterprise workloads with strong security and trustworthy performance.
- With Verizon Cloud, we can choose the flexible services required for our enterprise and secure our data in a personalized environment.
- Using Verizon Cloud, one can trim down the risk and retain the data integrity across the apps.
- Verizon Cloud helps to familiarize you to the varying business circumstances by gaining speed and reliability.



Introduction to Cloud Computing Application

Cloud Computing Application. Cloud Computing is the demanded technology in the era of the 21st Century. Here the availability of computer system resources, especially data storage and computing power, without direct active management by the user is seen to implement. Cloud Computing came into popularization with Amazon releasing its Elastic Compute Cloud product in 2006. Cloud has three types of computing-related services delivered remotely to the clients through the internet. Clients who join Cloud Computing services are entitled to a variety of benefits, depending on their business needs at a particular point of time. Cloud computing is dependent on the sharing of resources to achieve economies of scale.

Applications of Cloud Computing

Cloud computing technology has a large number of applications that are been used on daily basis for extracting several works.

1. There are several software's which are used to host files including documents, image galleries, presentation, videos, etc. Some of them are Media Fire, Rapid Share which is quite popular. This provides a user interface where users can upload and download the files with a certain storage space allowed and file size for uploading the contents.
2. There are large numbers of free applications online like Hulu, where a user can download the video related to movies, TV shows, etc. and view on their web browser.
3. Photo Editing has been a recent trend in the Graphics and Design industry but is there any application that does your photo editing work within a few minutes or seconds without the original image been damaged. Pilxr is a trendy online photo editor tool that involves cropping an image, resizing, face effects and much more special effects included.
4. There are many URL shortening services which help us to connect to the original website when clicked. But few times it may seem harmful or malicious as hackers might affect the privacy of the user. Some popular unique URL shortening services are been registered and part of the .ly domain (adf.ly, bit.ly (formerly default for twitter)).

5. Earlier antivirus was installed in all systems to provide internet security from malware. Nowadays as the cloud is been used common, its more efficient to install antivirus on your network which will act as a secure gateway for unauthorized access or malware which may affect your system, phones, etc. Few of them which are popularly used are Malware Bytes, Symantec Endpoint Protection, ESET Endpoint Security and many more.
6. Malware Bytes, launched in 2006 is an anti-malware software that works on all platforms and works by scanning in batch modes rather than individual files.
7. Symantec Endpoint protection cloud works on cross-platform and uses intelligent threat analysis and machine learning to monitor threats on all devices.
8. For an online creation of a presentation, a web-based cloud application named slide rocket is used to create an online presentation which can be accessed anywhere in the globe.
9. Cloud Applications have been used in finding direction and locations on the web. Some of the popular applications are Google map, yahoo map.

Use Cases of Cloud Computing

Several use cases have undeniable benefits, some of them are SaaS, IaaS, PaaS, Big Data Analytics, DRaaS.

1. Out of the three Cloud computing categories, SaaS is one of them. SaaS is related to Application service provider and on-demand computing software delivery model. There are several SaaS applications for businesses such as email, sales management, CRM, financial management, HRM.
2. IaaS is a cloud computing technology that provides virtual computing resources over the internet. Amazon Web Services and Google Cloud are a few examples of IaaS Platforms. IaaS users access resources and services through WAN.
3. PaaS is a cloud computing service in which a 3rd Party provider delivers hardware and software tools. PaaS model is similar to serverless computing and FaaS (Function as a Service) architecture in which the cloud service provider manages and runs the server and controls the distribution of resources.

4. Big Data Analytics is a complex process of analysing large and varied data sets to get the desired result for better decision making of the businesses. Big Data brands companies like Amazon and Facebook collect information on consumer buying behaviour like their likes, dislikes, reviews to predict future purchases and grow their businesses accordingly. The combination of cloud computing and big data techniques leverages scalable and cost-effective solutions.
5. There are several advantages and benefits of Big Data Analysis in the cloud platform which are listed here: With the advancement of cloud technologies, big data analysis provides better results as the cloud helps to integrate raw data from numerous resources.
6. Cloud computing is mostly used in Development and testing. Boomin, a managed service leader hosts development and testing in the cloud to create an experiment and deliver new products to clients.
7. BDP International a well known global logistics provider is hosting virtual desktops in the cloud which reduces capital expenses.
8. Creative solutions in Healthcare are accelerating the deployment of applications in the cloud.
9. Netflix a well-known player in the US for online content streaming. It partnered with AWS (a cloud computing platform) for services and delivery of content, where the users can access the content anywhere in the world.
10. The global leader in the pharmaceutical industry named Pfizer uses Amazon Virtual Private Cloud to enhance high performance for worldwide research and development.

Characteristics of Cloud Computing

Cloud Computing is becoming more popular day by day. Continuous business expansion and development demand large computational power and massive data storage systems. Cloud Computing can help organizations expand and safely transfer data from physical locations to the ‘cloud’ that can be accessed from anywhere. There are numerous characteristics of Cloud Computing that makes it one of the fastest-growing industries at present. The flexibility offered by Cloud services in the form of its ever-growing set of tools and techniques has accelerated its deployment across industries. This blog shall walk you through the essential characteristics of Cloud Computing.

List of the top 10 major characteristics of Cloud Computing:

1. Resources Pooling
2. On-Demand Self-Service
3. Easy Maintenance
4. Scalability and Rapid Elasticity
5. Economical
6. Measured and Reporting Service
7. Security
8. Automation
9. Resiliency and Availability
10. Large Network Access

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.

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 disruption. 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.

Introduction to IaaS

Introduced in the year 2012 by Oracle, IaaS is a cloud computing platform based model, known as Infrastructure as a service. Formerly IaaS was termed as Hardware as a Service (HaaS). Cloud computing has three distinct layers such as PaaS, SaaS, out of which IaaS is one. Here the customer organization outsources its IT Infrastructures, where customers access resources such as (server, storage, virtual machines) over the internet. Those resources are accessible in the cloud computing platform based on pay per use model. Here the clients are billed only for the services used, further, it helps to reduce cost and complexity of investing and managing a physical server

What is IaaS ?

- IaaS defined as “Infrastructure as a service”, provides visualized computing features to the clients through the internet. Also known as hardware as a service, it provides resources that belong to virtualized hardware termed as computing infrastructure that offers virtual servers storage, networking connections and IP address.
- IaaS cloud computing is distinguished into three models namely public, private and hybrid cloud. Public cloud states its location in a cloud computing platform, whereas in the case of private cloud the infrastructure is stored in customer place. In Conclusion, the hybrid cloud is the combination of both models where the customer chooses the best alternative.
- In detail, Public clouds are a common method of deploying cloud computing. Microsoft Azure is an example of a public cloud where cloud utilities like storage and servers are operated by third-party buyers and delivered over the web.
- The third-party buyers are the cloud service providers who own the hardware, software and several infrastructures. Public cloud costs the users less as no physical hardware or software needs to be purchased, the user has only to pay for the service he owns. Moreover, it provides high reliability and scalability with negligible maintenance.
- Private Cloud as its name says it comprises of resources to be used by one organization only. The private cloud can be installed physically at organization premises or else can be hosted by third-party cloud service providers. Private clouds are mostly used by government agencies, institutions, etc. This model provides more flexibility, greater security, and high scalability.

- Hybrid Cloud is comprised of both public cloud and private cloud. In a hybrid cloud, data and information can be transferred for better flexibility. Here we can say that the public cloud is used for where less security persists like webmail, whereas private cloud used when security is at peak and for critical business operations. A hybrid cloud is used for better control and cost-effectiveness that it provides.

How does IaaS Works?

IaaS points to an infrastructure either physical or virtual that is provided by the cloud provider. IaaS has lots of resources such as network, server, storage, virtualization, so it depends upon the customer to choose its resources wisely and as per need. Apart from the management of the infrastructures, it provides billing management too, where the user is billed as per the services rendered.

Benefits of IaaS

IaaS offers lots of benefits to its customers ensuring affordability and business growth. Given below are few benefits:

- IaaS provides a “pay per use” scheme, which says the services provided can be used as per needed, and users need to pay only for the services utilized.
- The services provided by IaaS are quite scalable as they make sure that the resources are available to the users at the desired time and demand and also ensure that there is no wastage of capacity if left out.
- It saves a lot of time and cost as the cloud service provider is responsible for setting and maintaining the physical hardware.
- The service provided is unaffected and remains constant, even though any hardware failure occurs.
- It provides a great value of flexibility as it scales down the resources quickly as per the needs of customers.
- IaaS mostly focuses on business growth as there is hardly any time spent on technological and business decisions and how to maintain the infrastructure. IaaS takes care of all of these.
- IaaS cloud computing platform provides secure data centres with 24/7/365 availability.

Examples of IaaS

IaaS is highly flexible and it's basically used in Ecommerce and Non-e-commerce platforms.

- A suitable example is Amazon Web Services (AWS EC2), where it provides scalability to host cloud-based applications, Moreover EC2 users need not have physical servers, AWS provides a virtual environment to work on. In this, the cost is minimized and the users only pay for the services they booked.
- In the Case of the E-commerce platform, it depends upon the user's interest in hosting the applications either on cloud or on-premise. Here also the users pay for the services actually used (i.e. hosting plan for the server).
- A virtualized Data Centre is established to provide cloud hosting options, integrating the cloud operations. The Data centre contains several Virtual servers that meet the user demand as per their business requirements.
- Another cloud computing service provider known as Digital Ocean, founded in the year 2011, which provides IaaS (Infrastructure as a Service) for open-source developers. Mostly Digital Ocean provides droplets, where a developer can resize the droplets after creating them. Developers can scale and grow their business through the Digital Ocean more efficiently.
- IaaS can manage big data to handle large workloads and integrate with BI tools.
- GCE (Google Compute Engine) is an IaaS component that runs search engine, Gmail and other services.

Introduction to PaaS

PaaS is a type of cloud computing product in which a service provider provides customers with a platform that enables them to build, operate and manage business applications without the infrastructure needed for such software development. Because the underlying infrastructures are not seen by developers and other users, the PaaS Architectures are similar to serverless principles, where a cloud service provider owns, operates the server and controls resource allocation.

What is PaaS?

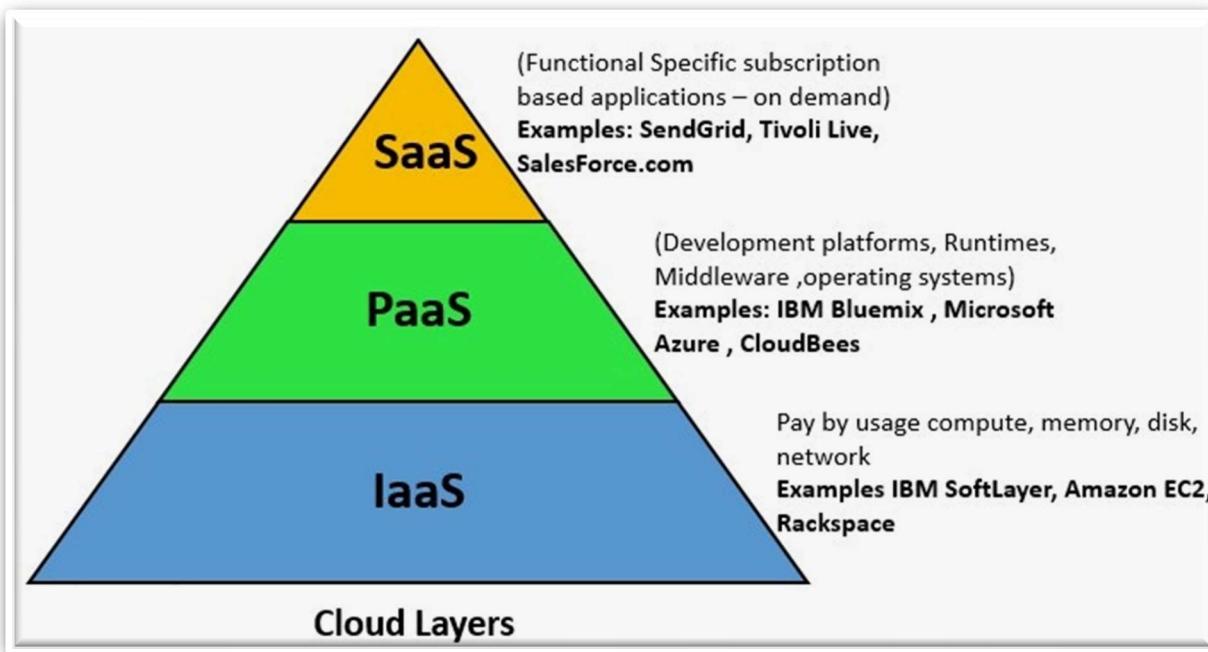
Platform as a service (PaaS) is a cloud-based development model that enables the user to deliver starting from simple applications needed in day-to-day life to centralized applications required for big organizations.

- The working procedure of PaaS is to provide a smooth working principle in the cloud that includes the entire application development phase in the cloud.
- In the PaaS cloud computing platform, the cloud service provider at the back end handles scalability and the end-user does not have to worry about managing the infrastructure.
- With the help of PaaS, we also get additional resources, including database management systems, programming languages, libraries, and various software development tools that works on cloud and made our daily life better.
- PaaS has varieties of usefulness and among them, it cuts down the price and headache of installing extra software licenses, core application, and other platform resources.
- PaaS architectures used to hide their underlying infrastructure from developers and other end users. As a result, the model becomes a serverless computing model and function-as-a-service architectures where the cloud service provider manages and runs the server and controls the distribution of resources.
- It helps us to organize and maintain useful applications and services whereas third-party providers maintain every other service in the cloud.

How PaaS Works?

Platform-as-a-Service, is one of the best cloud computing technology after IaaS that is less expensive, has a well-equipped management system and can beat any other old traditional cloud systems.

Nevertheless, how exactly does it work? I will provide some basic points that will contain the working principles of PaaS.



- PaaS is actually a sandwiched layer between SaaS and IaaS that contains all the middleware platform tools.
- PaaS provides a pay-per-use feature. Therefore, without having to buy, configure, develop, maintain and install every application to work and use for their purpose that also requires a strong maintenance team to maintain them and service them on a daily basis, one can easily just use and pay for that price that they require for their usage. That is why for proper and best utilization, one can pay only for their usage of their applications.
- There are various types of PaaS service providers are present that has very useful features. Those are:
 1. PaaS provides the user a basic data storage and server for maintaining all computing systems that are required for servicing.
 2. Support the use of powerful web engines and platforms including Google applications.
 3. Support social networking sites like Facebook.
 4. Daily essential commodities that really make changes to everyday life.

What's included in PaaS?

PaaS includes a variety of features and services. The main offerings included by the vendors are:

- **Development Tools:** PaaS vendors offer necessary tools for software development, including a debugger, a compiler, and other essential tools that work together as a framework. The specific tools offered will depend on the vendor, but PaaS offerings include everything a developer needs to build their application.
- **Middleware:** Platforms offered as a service include middleware so that developers do not have to build it by themselves. Middleware is software that is sandwiched between user applications and the machine's operating system. Middleware is necessary for running an application.
- **Operating Systems:** A PaaS vendor maintains the operating system that developers work on and the application runs on.
- **Database Management:** PaaS administer and maintain a database system. They will usually provide developers with a database management system as well.
- **Infrastructure:** PaaS is the next layer up from IaaS and has everything included in IaaS. A PaaS provider either manages servers, storage or purchases them from an IaaS provider.

Pros and Cons of PaaS

There are many advantages. Among them, I have listed down a few of those that are beneficial.

- **Simplified Development:** Programmers can focus on development and innovation without worrying about the infrastructure and cloud-computing tools minimize the time by taking less effort and using smart work using less code as possible to build the apps.
- **Flexibility and Portability:** Some PaaS service providers give the user lots of choices for using multiple platforms, such as PCs, laptops and other electronic devices in developing apps quicker and make it portable.
- **Affordability:** PaaS brings affordability for individuals or organizations to use cloud software of their choice without having to install extra software or shell out the extra cost in installing and maintaining software.

- **Collaboration with Development Teams:** Since applications made using PaaS can be accessed over the Internet, teams can work together globally irrespective of any locations.
- **Efficiency:** PaaS has been efficiently managing application development phases in the cloud that includes testing, managing and updating apps at regular intervals within the same cloud server and providing a quality and efficient infrastructure.

There are a few disadvantages of PaaS that I will discuss right now:

- **Data Privacy:** Data is a big risk and is kept private and stored in the server most of the time to maintain data privacy.
- **Integration:** There are chances that data mismatch can happen while integrating data because data are stored both in local storage and cloud. So, it is very difficult to differentiate them and the users felt difficulty while accessing the data whenever they want.

Introduction to SaaS

SAAS (Software as a Service) Cloud refers to the software licensing and delivery model where third-party cloud providers host applications and services over internet platform and the user requires a license for using those software services. SAAS is one of the topmost cloud computing services that gains its importance after the late 1990s extending the idea of the ASP model. It is typically based on the web and from 2012, SAAS vendors continue to develop and manage their own software. It has been widespread because of its flexibility, as it requires only a web browser to run.

What is SaaS ?

This represents the largest cloud application services that are growing immensely in today's digital market. As far as the name goes, it provides the necessary software as a service to the user that is managed by some third-party services. The software applications provided can be directly run on any web browser without any need for installing the software. SAAS is basically a web-based model that produces software on-demand, cloud vendors host application on the server, maintain database and transmit data over the internet to the end-user.

The SAAS vendor offers a great advantage over other service providers by allowing the buyers to outsource most of the IT responsibilities without having to invest in hardware platforms to host the software. SAAS cloud apps can be accessed by users via a web browser that has been a delivery model for various business applications including office software, management software, accounting, CRM tool, and various talent acquisition teams from various departments. SAAS cloud can be categorized into two types:

- 1. Vertical SaaS**
- 2. Horizontal SaaS**

SAAS Cloud has more benefits that will be discussed below which implements all the features of cloud computing making a robust experience.

Why We Use SaaS ?

SAAS Cloud is a technology that rents software-based cloud platform services and is also a replacement model for such cloud platform services that the organization can access. For the simplicity and reliability, anyone ranging from small to large-scale business use the technology of SAAS that needs internet connection to run with the help of a web browser. So, we prefer using the SAAS

Cloud because of various reasons. I will discuss some of the basic points which are as follows:

- For any scaled enterprise, they feel the necessity of using the SAAS cloud because of the low cost of services. We can purchase as much software as we want of our choice and will pay according to that.
- In SAAS, we do not require any IT specialist team to work for. So during a shortage of resources, or when application development and maintenance become a big issue, SAAS comes into the picture.
- SAAS application knows about its software creation that includes a bunch of experienced professionals and we can rely upon them.
- Using the SAAS cloud, everything is processed and stored on the cloud itself that makes it easier to store hundreds and thousands of files and can access the same from the cloud whenever we want.

Advantages of SaaS

There has been a significant paradigm shift in technology while using cloud services. If we talk about the SAAS cloud, it also offers quite a wide variety of advantages to make our life so much easy and worthy. We will see the added advantages that the SAAS cloud offers us which are given below:

- **Easy to afford services:** SAAS cloud model offers subscription-based services including service cost, maintenance, up-gradation cost, thus lowering the entire cost that are present on old traditional systems. Thus because of its affordability and wide range of features, many organizations started using SAAS.
- **Fast deployment:** For using SAAS services, we need only a web browser and internet connection. SAAS solutions omit the headache of installing software on the system. Using a fast, stable internet connection, accessing software will be very fast and components can be deployed instantly.
- **No setup required for infrastructure:** We, the users do not have to worry about the cloud infrastructure or hardware cost. SAAS cloud vendors handle everything. So there is no infrastructure cost as the SAAS vendor takes up all the responsibilities of maintaining the infrastructure as well as its configuration.
- **Fast upgrades:** SAAS cloud supports on-demand updates and hardware updates when needed. The upgrades are very fast as it eliminates the downloading of software and patches. The systems are upgraded or downgraded as per user's choice thus making our life so much easier.
- **Data backup and security:** SAAS also takes the responsibility of backing up of data on a daily, weekly or monthly basis that can be found very fruitful at times. SAAS solutions also initiate automatic backup maintaining data integrity and security making the user tension free.

- **Flexibility:** Users get a chance to access SAAS services from anywhere around the globe. It makes the life of job seekers who used to love doing work from home a peace for them. It only requires a strong internet connection to be connected to cloud services.

Disadvantages of SAAS Cloud

Thus, most companies prefer working with the SAAS cloud platform as it provides excellent features and works flexibility. Despite having many advantages, the SAAS cloud also has some disadvantages. They are:

- **Data security breach:** Since SAAS cloud runs mainly on an internet platform and there is only one server where all data gets collected and stored, there is a chance of data security breach. Unauthorized access and misuse of data can bring a big threat to the organization.
- **Termination of Service:** Business Organizations that use SAAS applications can lose their data if the cloud provider terminates their services due to lawsuits and various other reasons.
- **Performance issues:** Organizations that use SAAS that runs on slow internet speed can face problems of performance issues including daily backup, synchronizing apps and services.

Service Oriented Architecture Cloud Computing

Definition of SOA

SOA (Service Oriented Architecture) is built on computer engineering approaches that offer an architectural advancement towards enterprise system. It describes a standard method for requesting services from distributed components and after that the results or outcome is managed. The primary focus of this service oriented approach is on the characteristics of service interface and predictable service behaviour. Web Services means a set or combination of industry standards collectively labelled as one. SOA provides a translation and management layer within the cloud architecture that removes the barrier for cloud clients obtaining desired services. Multiple networking and messaging protocols can be written using SOA's client and components and can be used to communicate with each other. SOA provides access to reusable Web services over a TCP/IP network, which makes this an important topic to cloud computing going forward.

Benefits of SOA

With high-tech engineering and enterprise point of view, various offers are provided by SOA which proved to be beneficial. These are:

- Language Neutral Integration: Regardless of the developing language used, the system offers and invoke services through a common mechanism. Programming language neutralization is one of the key benefits of SOA's integration approach.
- Component Reuse: Once an organization built an application component, and offered it as a service, the rest of the organization can utilize that service.
- Organizational Agility: SOA defines building blocks of capabilities provided by software and it offers some service(s) that meet some organizational requirement; which can be recombined and integrated rapidly.
- Leveraging Existing System: This is one of the major uses of SOA which is to classify elements or functions of existing applications and make them available to the organizations or enterprise.

Key Benefits Along with Risks SOA

- Dependence on the network
- Provider cost
- Enterprise standards
- Agility

SOA architecture

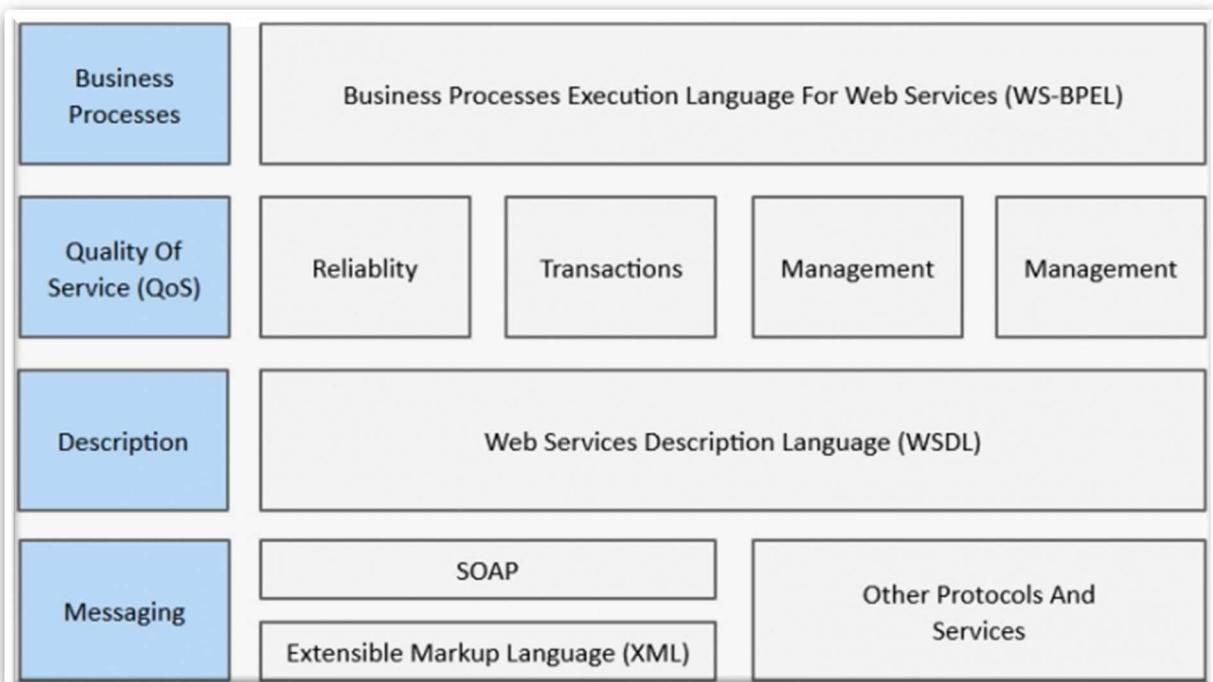
SOA architecture is viewed as five horizontal layers. These are described below:

- Consumer Interface Layer: These are GUI based apps for end users accessing the applications.
- Business Process Layer: These are business-use cases in terms of application.
- Services Layer: These are whole-enterprise, in service inventory.
- Service Component Layer: are used to build the services, such as functional and technical libraries.
- Operational Systems Layer: It contains the data model.

SOA Governance

It is a notable point to differentiate between IT governance and SOA governance. IT governance focuses on managing business services whereas SOA governance focuses on managing Business services. Furthermore, in service-oriented organization, everything should be characterized as a service in an organization. The cost that governance put forward becomes clear when we consider the amount of risk that it eliminates with the good understanding of service, organizational data and processes in order to choose approaches and processes for policies for monitoring and generate performance impact

SOA Architecture and protocol



Here lies the protocol stack of SOA showing each protocol along with their relationship among each protocol. These components are often programmed to comply with SCA (Service Component Architecture), a language that has broader but not universal industry support. These components are written in BPEL (Business Process Execution Languages), Java, C#, XML etc and can apply to C++ or FORTRAN or other modern multi-purpose languages such as Python, PP or Ruby. With this, SOA has extended the life of many all-time famous applications.

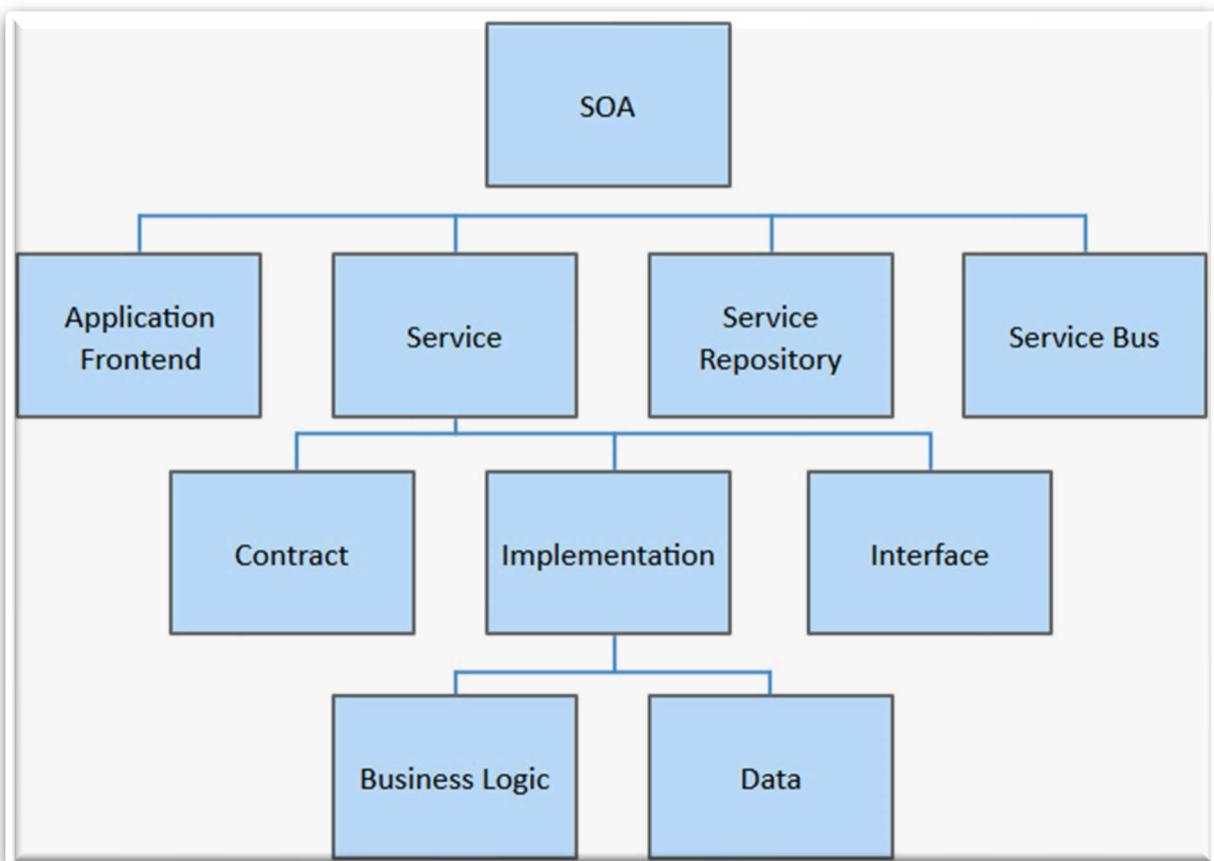
Security in SOA

With the vast use of cloud technology and its on-demand applications, there is a need for well - defined security policies and access control. With the betterment of these issues, the success of SOA architecture will increase. Actions can be taken to ensure security and lessen the risks when dealing with SOE (Service Oriented Environment). We can make policies that will influence the patterns of development and the way services are used. Moreover, the system must be set-up in order to exploit the advantages of public cloud with resilience. Users must include safety practices and carefully evaluate the clauses in these respects.

Elements of SOA

Here's the diagrammatic figure showing the different elements of SOA and its subparts:

Figure - Elements Of SOA:



Parts of Cloud Computing Environment

Cloud computing environment is a new, great approach to providing IT-related services. In fact, this approach is a dream of numerous business owners who wish to get all possible IT services at one place. In the era of informational society this kind of services is becoming more and more popular, as it helps entrepreneurs resolve all IT challenges within one company quickly and efficiently. In simple terms, cloud computing environment is all about IT and what IT needs: different kinds of software and hardware, pay-per-use or subscription-based services offered both through the Internet and in real time. So, let's define the most common kinds of services which usually refer to what we call cloud computing.

1. SaaS or Software as a Service

Because all businesses are unique, they may require unique software to perform their tasks. It can be very costly and ineffective to purchase pricey tools which you are going to use partly. For this reason, there are SaaS companies, like isutility.com. Software as a service firms help resolve any issue regarding software required for your particular service. These companies license various applications on a pay-per-use base or a subscription.

2. Utility Computing

This service is probably the most popular element of the cloud computing environment. It implies ability to access virtual storages, as well as purchase capacity on the remote servers (this option is more popular than buying specific machines). Utility computing is a provisioning model that maximizes the efficiency of the used service by minimizing IT-related budget. The term ‘utility’ is used as an analog to other services, like electrical power, where customers pay for consumed product, rather than a flat rate. This approach is also known as ‘metered service’.

3. Platforms

IT platforms of foundations are a variation of Software as a Service. By delivering platforms, IT firms provide customers with whole development environment rather than just single application. Such platforms encompass all tools required for developers' work.

In addition to the aforementioned services, cloud computing implies other functions, anything from installing hardware to virus scanning. In fact, any kind of IT-related service that was ‘outsourced’ falls into the ‘cloud’ of the company that provides complete computer services.

Module 2

Introduction to Cloud Technology

Cloud computing is the delivery of various internet services. Such tools include data storage, servers, databases, applications and networks. Cloud-based storage allows you to save files on a central network rather than on a proprietary local storage device or hard disk. So long as an electronic device accesses the internet, the data and software programs are available for use. For many reasons,

Cloud Computing is a popular option for individuals and companies, including cost savings, productivity increase, speed and efficiency, performance and protection.

What is Cloud Technology?

Cloud computing technology is an on-demand technology where users utilize the IT resources over the internet platform and work on pay-per-use mechanisms instead of the previous subscription-based technologies.

Below are a few points:

- It refers to cloud computing which stores data and resources in an online server, and user fetches the same for their use instead of saving directly in the computer's hard drive, which is not secured and safe for use.
- Cloud here refers to virtual space or online platform, and the technology becomes widespread where the end users can store large files and applications on remote servers, which gives them the facility to work remotely from anywhere in the world.
- Some of the Cloud technology services provide the end-users to consume the facility at a certain price, where some technology services provide facilities over the network to some specific set of user clients to use the resources.

There are various cloud technology services, which are very popular and widely used in today's world are huge storage and its backup, testing and maintaining apps, analysing data and delivering relevant software on demand.

Why we use it?

Cloud computing technology is an internet-driven platform where resources are transferred through channels of networks from server to client that replaces the use of physical hardware and software.

Therefore, in today's world, where technology is upgrading at the speed of light, it is very important to know which technology to go for and the right use of technology. Thus, cloud technology comes in, and despite having adverse effects on the internet, it remains the fastest technology to work with, and it became the latest trend in today's market. So the purpose of using it is to diversify resources worldwide by interconnecting customers and giving the business users the to expand their market by retaining their customers in this field by utilizing the proper resources at the right time. The biggest reason, according to me, why everyone uses the cloud is that it provides us with the best backup system of any resources of any file size that can be corrupted or become unusable if kept in a local drive or storage. It has been a tremendous boom in the recent trend of technologies for IT professionals where they can access resources and work from anywhere in the world, making it more flexible to work and handle clients.

Advantages

If I started to write about the benefits, we can get from Cloud technology, it would be a never-ending topic since its advantages are vastly eradicating its minor disadvantages.

In spite of that, I have listed down its major advantages that are worth considering:

- **Cost Optimization:** This technology brings a variety of useful resources that utilise the overall cost and saves the cost. This technology does not require any physical hardware installation, and the user can use it on a pay-per-use basis rather than subscription charges.
- **Scalability and Resource Utilization:** This technology offers the best scalability by utilizing the resources across the platform, offering better reliability of storage for the users.
- **Data Security:** Having a huge amount of data stored in one cloud server still provides the best data backup and the security of its resources and makes it readily available for the users whenever they want to do something with it.
- **Collaboration and Ease of Use:** The cloud technology platform provides an effective collaboration that makes the users to be interconnected from anywhere in the world by using the internet, connected virtually.

- **Fast Software Updates of Resources:** Software updation and upgradation happen automatically and quickly without any requirement of manual steps to integrate applications of choice.
- **High Speed and Flexibility:** Cloud computing services are readily available for the clients to work, and the high speed of acquiring and utilizing the resources makes them work from anywhere and anytime.
- **Rapid Deployment:** The cloud technology platform gives us access to deploy the resources faster over the cloud. Thus, after deployment, the resources and the system deployed become fully functional and ready for use within a few moments.

Working of Cloud Technology

Cloud Technology nowadays provides a variety of useful services that requires an internet connection, and users can access and download data from any physical devices anywhere, anytime they want. The users also are benefitted from the use of various cloud storage providers that provides unlimited free cloud storage spaces minimizing the use of limited spaces available on CDs, DVDs, and pen drives.

The main model of cloud technology works in two layers are:

1. Front End

This end comprises of the client or user systems having their own user interface. This end also consists of the necessary resources that the client requires for their use. This end is the receivers that receive the resources through cloud-connected through the internet.

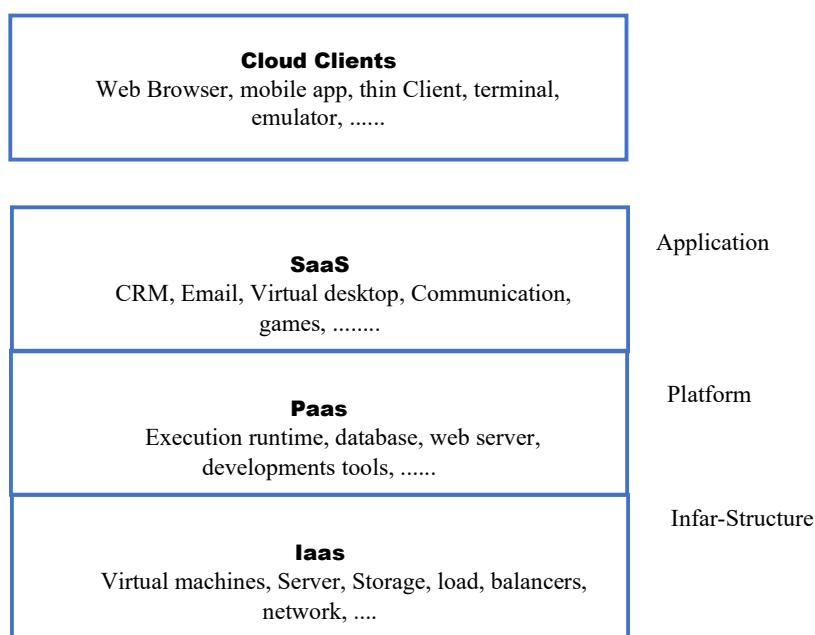
2. Back End

This end comprises of the data storage systems and the servers that make up the cloud. It contains a dedicated server to work on cloud performance.

Cloud Client

A Cloud Client consists of computer hardware and/or software that relies on cloud computing for application delivery. A Cloud Client could also be specifically designed for delivery of cloud services. In either case, the Cloud Client is essentially useless without Cloud Services. Examples of Cloud Clients include some computers, phones and other devices, operating systems and browsers.

Users access cloud services by using networked cloud client devices, such as desktop computers, laptops, tablets and smartphones. Some cloud clients rely on cloud computing for all or a majority of their applications so as to be essentially useless without it. Examples are thin clients and the browser-based Chromebook. Many cloud applications do not require specific software on the client and instead use a web browser to interact with the cloud application. With Ajax and HTML5 these Web user interfaces can achieve a similar or even better look and feel as native applications. Some cloud applications, however, support specific client software dedicated to these applications (e.g., virtual desktop clients and most email clients). Some legacy applications (line of business applications that until now have been prevalent in thin client Windows computing) are delivered via a screen-sharing technology.



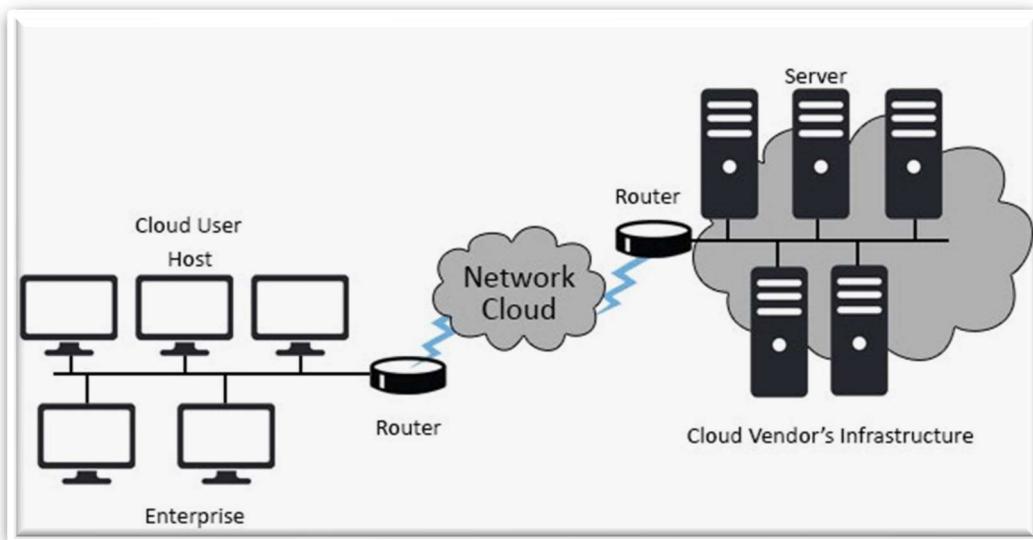
Introduction to Cloud Networking

Cloud Networking is a service or technology in which the company's networking process is hosted on a public or private cloud. Cloud Computing is a source control in which multiple computing resources share the same platform, and the users are also enabled to access these resources to a particular extent. Cloud networking similarly shares the networking, but it provides more advanced features and network functions in the cloud with interconnected servers established under cyberspace.

Why Cloud Networking?

Know why cloud networking is required and in demand:

- Many organisations in demand for their fast and secure delivery, rapid processing, and reliable transmission of data without any loss, pocket-friendly set-up. The benefit of companies who prefer Cloud Networking includes web service providers, e-commerce, cloud service providers, network operators, and cloud service providers.
- It allows users to develop their networks according to the requirements of cloud-based services. An authentic cloud network offers high-end monitoring to the globally located servers, controls the traffic flow between interconnected servers, protects the systems with advanced network security and gives visibility to the user by its centralized management. Internet access can be improved and made more reliable bandwidth to promote multiple network functions into the cloud.



- The above diagram shows the operation of Cisco. It shows the separation of resources from the user, and then they connect it with the cloud. It includes the management of distributed wireless access to the routers, and in addition to it provides all the high-tech features as mentioned above. The aim is to design and manage new cloud networks with more secured private access by a wide area network.
- Software-Defined Wide Area Network is a technology that uses a bunch of networking switches and routers to virtually access the device from hardware to software deployed on a white box. Confidential devices and data are installed on the main branch office or client location and given special access to the administrator to access its advanced networking functions, cloud optimization software, and firewalls. It is a huge range of array with network functions deployed in the cloud platform.
- It ensures performance and security in a multi-cloud environment so that Information technology gets more visibility by providing end-users with the requirements and experience they need. Workloads are shared between the cloud environment using the software as a service application. The protection is given to the user to access the web page and infrastructure by moving the applications to the cloud with a typical security model. The gateway provides a contextual access code and a multilayer firewall. Applications and services are given to distributed data centres in a cloud environment.
- Software-defined Wide range network gives the traditional load balancing method and combines all ranges of the network to user experience. It gives more visuality with the help of intelligent analytics. Giving solutions to each cloud user may be difficult, but the leverage of all the services and offering them a unique solution by SD-WAN from end-to-end applications.

Benefits of Cloud Networking

The benefits are set out below.

- **High Scalability:** It requests the supply of resources on a huge scale without any human intervention with each service provider.
- **High availability and Reliability:** The servers are available at the right time without any delay or disappointment.
- **Agility:** It shares the resources effectively among the users and works quickly.
- **Multi-sharing:** By distributed computing, different clients from multiple areas share the same resources by fundamental infrastructure.
- **Maintenance:** It is user-friendly as they are easy to access from their place and doesn't require any installation set up.
- **Low Cost:** It is very cost-effective and pays according to its usage.
- **Services in pay per use Model:** Application Programming Interface is given to customers to use resources and services and pay on a service basis.
- **On-Demand Self Service:** Cloud computing offers the required services and application to the client. With the login key, they can start to use it without any human interaction and cloud service providers. It includes storage and virtual machines.

Types of Cloud Networking

The following four types are listed below.

1. Public Cloud

It is managed by a third party which offers cloud service over cyberspace to the public. They are available as pay as use billing methods. They give solutions to the IT sector to minimize the cost set-up and also to handle the peak load infrastructure. A fundamental attribute of the public cloud is multi latency. It provides services to multiple users by the virtual computing method.

2. Private Cloud

It is a distributed system that works on private enterprise and provides dynamic provision. It gives customer protection by giving more security and protect their sensitive data. The private cloud ensures accurate clustering, data replication, system maintenance and system and quick response time. Compliance with standard instructions and procedures. Public resources do not access this.

3. Hybrid Cloud

A hybrid cloud is a mixed distributed system resulted from combined features of both public and private attributes. But the major disadvantage is the inability to scale on-demand and difficult to address peak loads.

4. Community Cloud

They are distributed systems by desegregating the services of a variety of cloud environments. The media industry needs quick, simple, minimum response time to increase its efficiency. It involves extending the community cloud ecosystem. It simplifies complex workflow executions. The healthcare environment shares knowledge on the world level and protects sensitive information.

Server Virtualization

Server Virtualization can be described as a process of creating and implementing multiple copies of one physical server into several virtual servers, which is used for imitating the actual server in all the virtual servers and the performance of the virtual servers are same as the original server. It is important to keep the virtual servers in synchronization with the one physical server. This method is used for a few special purposes, like for the purpose of consolidating the physical servers, for the purpose of data recovery in the case of data lost from the databases, and for the purpose of virtualizing the web servers.

How Does Server Virtualization Work?

It is done by separating the software with the hardware, this is done using a software component called a hypervisor. Hypervisor are of different kinds which are available in the market

- **Type 1 Hypervisor**
 - This is the most commonly used hypervisor it is directly placed on the server, and from there it performs the partition work. That is the reason it is said a bare-meta-hypervisor
- **Type 2 Hypervisor**
 - This type of hypervisor is most often used with the software with the operating system.

This hypervisor is generally used for the testing servers or lab servers

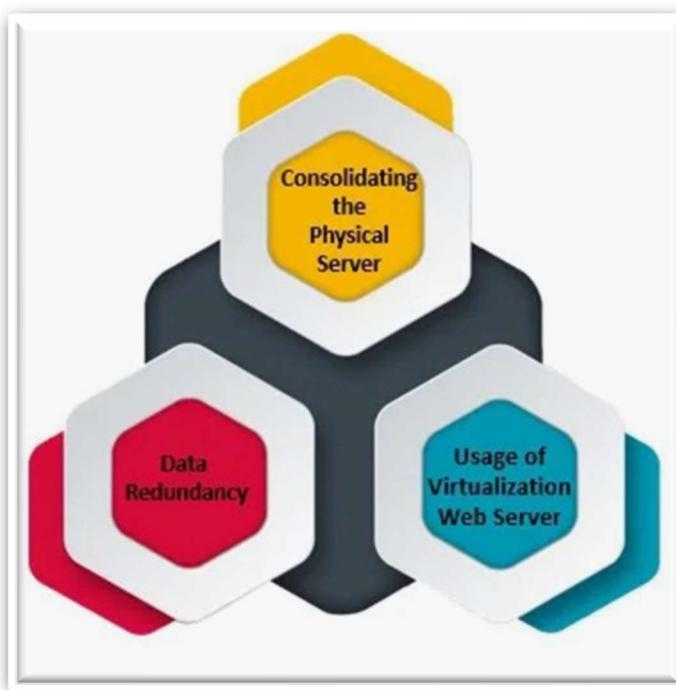
The virtualization work is done using the following steps

1. First, an organization which wants to virtualize its servers must identify which server is not used to its full capacity, the server which is not used to its full capacity are the best candidate for the server visualization so, virtualization helps to utilize those unused resources of the server and reutilize for other works
2. Once the server is identified then the organization should monitor the resource usage of the server. The resource includes the memory, disk usage and the different kind of loads which needs to be monitor thoroughly before implementing the virtualization.

3. Once that part is completed then the user can deploy the virtualization software to create a partition of the server. Any software such as Microsoft Hyper V or VMware etc. The selection of the software depends on the server and it is physical (hardware) configuration
4. Once the partitioning or rather the virtualization is completed then the server needs to be monitored again for the resource usage and performance after the migration.

Usage of Server Virtualization

The various usage of the server virtualization are as follows:



1. Consolidating the Physical Server

- Virtualization for the server helps in consolidating the server which means 1 single physical server can act as multiple servers due to partitioning and each partition can cater multiple clients with different needs.
- So, to maintain the hardware of the 1 physical server the company will not require much cost, compared to that of multiple servers.
- So basically, it helps in cost-cutting and proper management of the IT infrastructure

2. Data Redundancy

- If an organization uses virtualization and copy, their data in multiple partitions then it helps them to keep their data safe. If the one partition is lost or if the data in the one partition gets deleted, they can still recover it using the other partition.

3. Usage of Virtualization as a Web Server

- To get a web server to host a website is a costly task, virtualization can help in this if a server is virtualized then a dedicated part of the server can work as a web hosting platform for the website.
- If multiple partitioning is done then it can host multiple websites all with different requirements, such as different resource configuration, operating systems and we can customize the partition as per the requirement of the website.

Advantages

There are various advantages as follows:

- Less use of physical and costly resources since virtualization helps in sharing and distributing limited resources.
- If we do virtualization, we are basically performing a live migration of data with the help of software
- Virtualization also helps in reducing the use of physical devices
- The virtualized partition of the server can run its own software and OS independent of the other partition and the actual physical server.
- This helps in reducing the cost of the servers
- If virtualization is done, then it is quite easy to back up the current state of the server and restoration is also quite easy if the server runs into some trouble
- Virtualization also helps in reducing the energy and power consumption.
- If the server is partitioned into multiple parts using virtualization, then it can help in consolidating the server.
- Through virtualization, it is easy to install software and security updates and patches quite easily.
- Virtualization of the server is the easiest and cost-effective way for hosting websites.

Cloud Computing Security

Cloud computing security refers to the security enforced on cloud computing technology. In simpler terms, cloud security provides support and security to the applications, infrastructure, and procedures and protect data from vulnerable attacks. Cloud security came into existence because of the vast infrastructure of cloud computing systems that runs online and requires proper maintenance daily. There is only one single server where all user data are stored, so in order to utilize resources, in order to restrict user data to get leaked or viewed by other users, cloud computing security handles such sensitive computing resources.

Cloud Computing Security Works?

Various organizations now these days have moved to cloud-based computing systems for ease of work and to save time and money. The business has been uplifted to new cloud service technologies replacing the traditional practices. Thus, to provide controls and safeguard applications and cloud applications, cloud security came into existence. There are a lot of risks and concerns as per as online flow of data is concerned which includes data breach, data hijack, unauthorized access, system malfunction, etc.

To handle such risk and take care of the user needs and to maintain the database, cloud computing security ensures proper security by working in various ways:

- Old traditional technologies lack the measurement of giving full protection to the server. With the advent of cloud computing security, the data first goes to the cloud instead of passing directly through the server that acts as a medium. In that way, the data is transmitted to the authorized user who has access to it before directly reaching the server. This maintains data integrity and the cloud blocks unwanted data if any before reaching the server.
- The traditional approach consists of applications that filter the data are very costly and difficult to maintain. The data filtration is done upon reaching its desired network and in the midway due to large chunks of data, systems get crashed and shut down completely while filtering good and bad data without proper utilization. The web security services solved it by working on a cloud model where data gets filtered in the secured cloud itself before reaching other computing systems.
- Cloud-based security platforms also work on a private model that consists of a private cloud, isolating the unauthorized data access from the clients ensuring protection from shared security platforms.

- Cloud computing security also works on securing data identity by deciphering the encrypted data to the desired users who need access to it.

Why Cloud Computing Security is important?

Traditional computing systems offer a great approach of transmitting data but lack the security system that eventually unable to control data loss and data integrity which is very important in computing systems. This is where cloud computing security takes the advantage and it is very important because the security model is purely defined in a cloud server that provides the best resource backup and security when data is concerned. The cloud computing security that provides a variety of data services including data backup, virtual desktop, and other communicating tools, has increased tremendously from the year 2015.

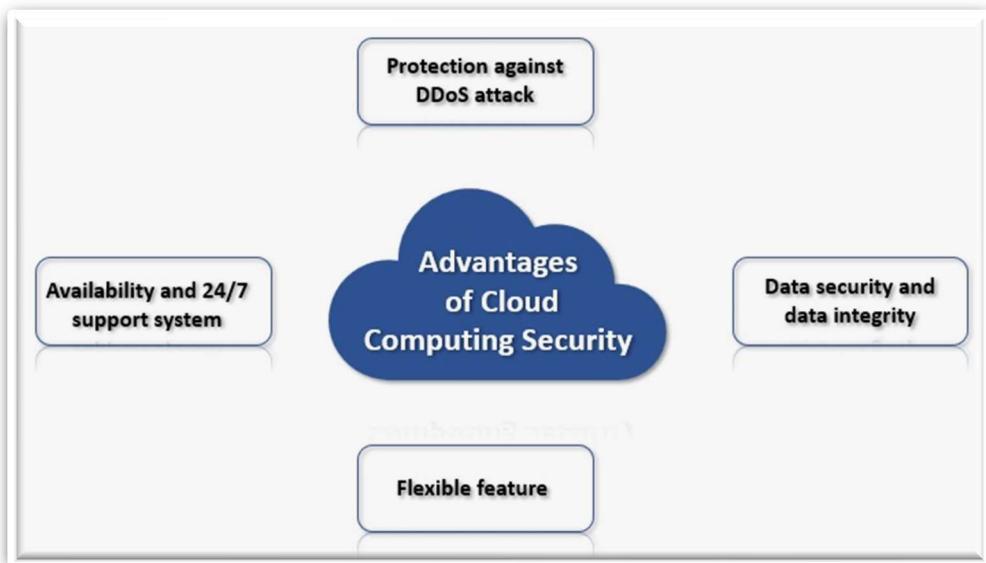
The cloud model is important in several ways:

- Ensures proper data integrity and safety since the data that gets transmitted online through server are sensitive data.
- Lots of hacking cases have been observed while transmitting data that is a very common topic for any business purposes but cloud computing technology assured us the best safety feature system for all cloud storage devices and applications.
- While cloud technology provides cloud provider services at a very effective cost, the security systems also came to provide the most efficient platform at such cost benefitting for every user.
- There have been various government regulatory authority services that ensure why cloud security and choosing the right cloud provider are equally important. Under the Data Privacy Act, the cloud providers perform efficiently which outsources the organization's critical data over cloud protecting every customer's private data utilizing every service of the cloud provider.
- The third-party providers also get in touch with the cloud systems that provide necessary security and data privacy and also encrypt data before reaching directly to the client.

Advantages of Cloud Computing Security

Cloud computing has created a tremendous boom in the recent technologies that help the business to run online, to save time and cost-effective. Therefore, besides having a lot of advantages of cloud computing systems, cloud computing security also plays a major role in this technology that ensures clients to use it without any risk or tension.

Below are the advantages of cloud security:



- **Protection against DDoS attack:** Many companies face the Distributed Denial of Service (DDoS) attack that a major threat that hampers company data before reaching the desired user. That is why cloud computing security plays a major role in data protection because it filters data in the cloud server before reaching cloud applications by erasing the threat of data hack.
- **Data security and data integrity:** Cloud servers are real and easy targets of falling in the trap of data breach. Without proper care, data will be hampered and hackers will get the hands of it. Cloud security servers ensure the best quality security protocols that help in protecting sensitive information and maintains data integrity.
- **Flexible feature:** Cloud computing security provides the best flexibility when data traffic is concerned. Therefore, during high traffic user gets the flexibility in a happening server crash. The user also gets scalability resulting in cost reduction when the high flow of traffic ends.
- **Availability and 24/7 support system:** Cloud servers are available and provide the best backup solution giving constant 24/7 support system benefitting the users as well as clients.

Cloud Storage

Cloud Storage can be defined as a virtual memory unit that allows users to create, update, delete and perform all manipulative operations on the data with the use of the internet. In this storage method, files and folders can be stored in the internet-based cloud memory offered by the cloud service providers. This enables the users with options to access the data and files from anywhere, from any device, at any given point of time, and also allows to share these data to anyone across the network.

Why we use Cloud Storage?

- Earlier days, it was a common sight of seeing people carrying flash drives and other storage devices that contain much crucial information related to them. But it was easy losing the drives and losing all the relevant information. The file backup is not easy as a backup also requires another device with the same storage level. Storage capacity will also depend on each device but we were not able to store lots of data. And in order to transfer data from one person to another, we should find a system and it takes a long time to complete the file transfer if the files are big.
- If any bug or virus enters the device, chances of losing the data and files are pretty high. Also if the device stops working all of a sudden, all the hard work will be wasted. Here cloud storage came as a savior with less money and more power. We can access data from anywhere in the world without carrying the storage device physically. Since the files are saved online, any computers can be used to store data. Backups are easily made for the data.
- Data has been increasing a lot nowadays from all the places of business and it became necessary to store data in a safe place and without physical hassle. Also when the customer segment grew, their needs changed and they were ready to take risks considering the ease of storage. Risk comes from the safety of the files. Now the companies need not worry about the maintenance of the files as it is taken care of by cloud providers. The flexibility offered by cloud storage is appreciable as employees can log in from anywhere and check the information needed for them.

How does Cloud Storage work ?

- Data of the user is stored in servers that are in remote locations. The user is connected to the server where his/her data is stored via the internet. Now the user uploads data into the internet and sends it to the data server connected. This data server sends the same data to different servers stored remotely. This data when needed, users can access through the internet.
- The data is stored in different servers because the server through which the user is connected may not be available at the time of his need. If the server faces a problem due to maintenance, less worried is the user because the data is stored in other servers as well. This storage if in the public cloud, the primary storage will be near the physical location of the user due to its faster availability and lower cost. Public clouds have servers, storage, networking, and data centre operations as their services.
- Cloud services are used by paying a certain amount fixed by the service provider based on the storage and usage of the end-user. Users who know their usage can pay the amount prior to the usage and then a monthly rental will be almost free. A service provider can also add the servers on a dynamic basis and here the payment is based on a pay per use basis. Cloud storage can be personal, private, public and hybrid cloud storage.
- The difference between personal and private being personal storage will be mostly owned by a person to store graphics and texts while private will be owned by a company for its data storage. Most of the cloud storage is virtual machines that have servers located elsewhere around the globe. We can upgrade the cloud storage once the storage option changes according to the data to be stored.

Advantages

Below are the advantages mentioned:

- Data is accessible from any parts of the world with the help of the internet as it is stored online in servers.
- Data can be shared easily between persons or devices with cloud storage.
- Communication with the data can be done easily as the sharing is done automatically by providing a link like Google Drive.
- Companies need not worry about the maintenance of the storage devices as it is managed by a service provider.

- Data is protected easily with the cloud rather than with storage devices. As the user need not worry about hiding the device from intruders, data is stored safely.
- Backup can be created easily with cloud storage as the data is stored in many servers and it is available online.
- Money can be saved due to its maintenance, buying physical devices, the space to keep the devices and supporting staff to do the work needed.
- Once moving all the files to the cloud, the system will have lots of space. In short, the system is free of any large files and can work freely.
- A copy of the data is stored locally near the user's region and it helps in regulatory compliance of the data.
- When data is stored in physical devices, one should be careful about the virus attacks. Cloud storage relieves the users from such kind of burden.
- Cloud storage does its backup through automation and hence the business is not disturbed in companies.
- Multi-users can access the data and make changes to the same file and hence it saves time in away.
- Scaling can be done easily in the cloud according to the use of storage space.

Internet usage will be more and the backups will not be easy as it says. Security is a concern particularly when files are stored in the public clouds. Other than these concerns, cloud storage is the blessing of the current generation.

Cloud Data Storage Service

We are living in an age of technological innovations which have come to revolutionize the way we interact, communicate, socialize and work. Change is the only constant in such a scenario and with every breakthrough, new challenges are born. One such challenge faced by the global industry today relates to the efficient management of data arriving from different sources. Technological advancements have made it possible to gather real-time data related to business processes, financial transactions, business-to-business interactions, and customer interaction data among other things. To store and process these massive amounts of data is simply not possible with the help of conventional methods.

Usually, corporations invest a great deal in managing extensive physical IT infrastructure for its data storage and processing needs. However, the pace at which data is being accumulated these days has made it near-impossible for business to scale up their physical infrastructure to match the storage and processing needs. To fill this gap, cloud computing has emerged as an innovative and sustainable solution for modern data management needs. To understand what exactly is cloud computing about, it is essential to grasp the concept of a virtualized infrastructure.

What is Cloud Computing?

Usually, cloud data storage service is offered by vendors who manage the physical infrastructure and provide online access to specific software or other computing resources to its customers. This remotely located physical infrastructure includes a network of servers and other physical resources, sometimes even spread out geographically. Anyone can buy limited access to specific software through the cloud and scale up or down the resources in keeping with their needs.

This allows corporations to do away with the need to manage extensive physical resources and focus on the operational aspect and spend more time on improving their efficiency. Today, an increasing number of businesses prefer utilizing a best cloud data storage service instead of managing on-premise infrastructure for meeting their specific needs. Cloud computing affords a host of advantages to users including increased levels of flexibility, scalability, ease of access and cost-effectiveness among other things.



Advantages of Cloud Computing

Cloud computing offers a host of benefits to business as well as individual users including:

- **Flexibility:**

Usually, it is offered on a subscription-basis which lets users decide the number of resources to be used without worrying about installing or managing a software or managing the hardware resources. The vendor offering cloud data storage service is responsible for managing the remote infrastructure and users pay for only how much and for what amount of time they utilize the resources.

- **Economies of scale:**

It is self-evident that end users of cloud data storage service do not have to worry about burning physical resources and managing them even when not in use. Cloud computing capabilities help reduce the need for extensive physical infrastructure and manpower along with the time and resources needed to maintain them, resulting in an enhanced operational efficiency of an organization. This helps an organization achieve economies of scale by reducing the overall cost incurred on every product or every unit of output as compared to traditional methods.

- **Easier Collaboration:**

Cloud-enabled product or project development allows team members to collaborate more efficiently and share their inputs in real-time, thus reducing time spent on views and reviews on certain aspects of product design or process. Greater visibility, collaboration, and instant file sharing are only some of the benefits accorded to users. Shared online storage and the ability to access the resources from almost anywhere at any time lets users make the most of available resources in a real sense.

- **Enhanced Security:**

Data protection is a million-dollar question for individual users as well as small and big firms of all kind. Although some might have some security concerns, considering the physical resources are managed by the vendor and thus potentially data could be compromised. However, adequate measures are taken while providing cloud-based access to any kind of software or hardware resources so that no data loss occurs and even more importantly, data security is not compromised. Users are in complete control of the data stored on their shared storage and this is why big corporations are finding it rather easy to rely on cloud-based infrastructure.

- **Disaster Recovery:**

Data loss is a serious concern in modern organizations and any kind of hardware or software glitches could be responsible for losing data in a traditional setting. However, it has changed the picture drastically and any hardware failure or other technical issues would not affect crucial data as long it has been stored on the cloud. It helps minimize the loss of productivity which plays an important role in enhancing the efficiency of organizational processes.

As per a study conducted by the market research firm Vinson Borne, called “The Business Impact of the Cloud,” adoption of cloud data storage service has made a visible impact on businesses. The study points out that cloud adoption makes a measurable impact in terms of improving average time to market, improving process efficiency and lowering operational costs along with several key factors that lead to a quantifiable increase in company growth. However, it is cloud data storage service which rules the roost when it comes to cloud data storage service and as an increasing number of people have been using cloud data storage service to back up their personal and business data.

Cloud Data Storage Service

Some of the best cloud data storage service options of the day include –

Dropbox

Dropbox is arguably one of the most popular cloud data storage service options in the market offering 2GB of storage space as part of the free basic account. This may not suffice for the storage needs of most individuals today, given the relatively large size of media files shared but it is possible to expand this storage space in several ways.

Additional Storage:

Simply for taking a tour of the basic account, you will get an additional 250 MB and if you choose to set up a Mailbox account, you can get an additional 1 GB of storage. You can refer friends and get an extra 500 MB of storage against every sign-up. There is a cap of 16 GB on the additional space you can get through referral. Enabling camera upload feature would get you a straight benefit of 3GB in your storage space.

Paid Subscription Plans:

Alternatively, you can subscribe to a plan of £9.99 per month for 1TB storage. For paid business users, Dropbox Business is an excellent choice with unlimited storage for \$15 per month on the offer. To check out the utility you can avail a 30-day free subscription as well.



Google Drive

If you have a Gmail account, you have got 15 GB of free cloud data storage service space on Google Drive, an innovative cloud data storage service offered by Google. It is among the most efficient and easy to manage cloud storage options available these days. However, it is important to keep in mind that this 15 GB of free cloud data storage service space includes the entire suite of Google services and is not limited to Google Drive.

This limits the actual storage space available for regular users of Gmail, Google Plus and other services; still, there is plenty of space left for an average user. The ease of uploading and downloading data from Google Drive also sets it apart from others. Syncing files is easier than ever with Google Drive and can be shared across Google services instantly.

Additional Storage:

Chromebook users get an additional 1 TB of free cloud data storage service for 2-3 years.

Paid Subscription Plans:

Users can subscribe to a monthly plan of \$1.99 for 100 GB of storage or pay \$9.99 per month for 1 TB of storage.



Google Drive

Microsoft OneDrive

Microsoft's native cloud storage option OneDrive, formerly known as SkyDrive, comes with 15 GB of free storage. OneDrive functions flawlessly with the latest version of Windows and becomes easy to use with desktop apps available for earlier Windows versions as well as for Mac users. OneDrive apps for Android, iOS and Windows platform are also available, making it easy enough to use with an entire range of mobile devices. To the advantage of avid gamers, there is even a specially designed OneDrive app for Xbox users.

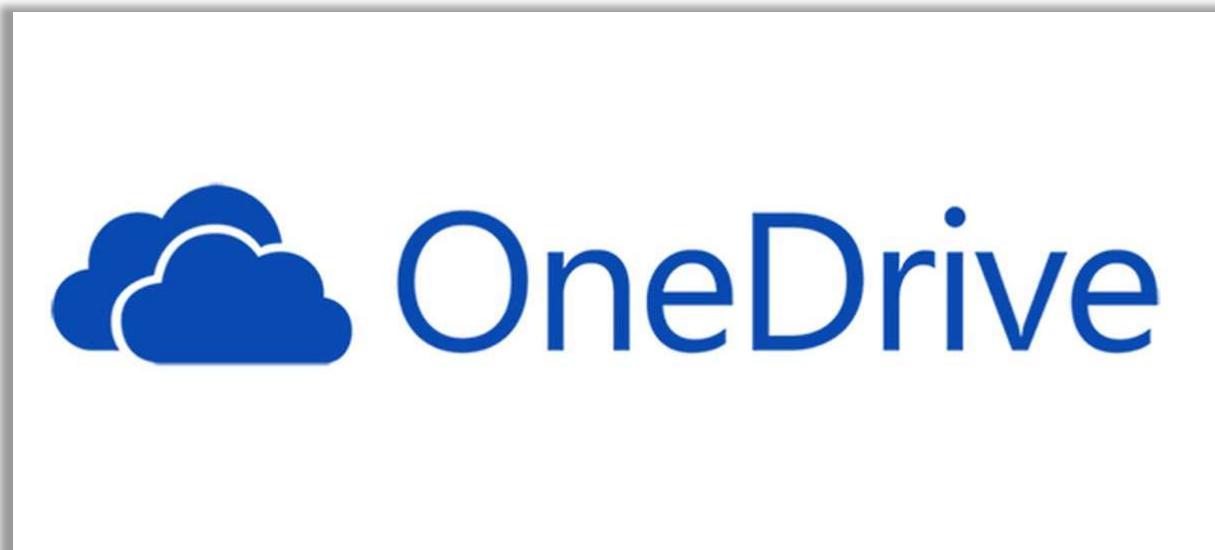
Additional Storage:

Those looking to expand the storage size can add 500 MB per referral with a cap of 5GB.

Paid Subscription Plans:

For additional storage space, users can pay \$2 per month for 65 GB, \$4 per month for 200 GB and \$7 per month for 1 TB of storage. With the 1 TB plan, users get free access to Office 365 Personal as well.

For obvious reasons, those heavily using the Microsoft Office Personal and Windows OS, OneDrive deliver greater value in every sense of the word. However, users who have moved away from MS Office may not find it a very attractive option.



Apple iCloud Drive

Those using an Apple device can make good use of iCloud Drive with its free 5 GB of storage space and it works just as well with Windows as it does with iOS and OS X devices. However, there is no app for using iCloud Drive on Windows phone or Android and Blackberry, thus limiting the access to mostly within the Apple ecosystem of platforms and devices, of course, with the exception of Windows PC.

If you use an iPhone, an iPad or a Mac, then it is a valuable addition for sure. Those looking for a complete office suite, iCloud's integration with iWorks would do well enough. iWork's is a beginner's office suite developed by the Apple. It helps create something parallel to what Google has achieved with its complete cloud-based office with seamless integration of Google Drive and Google Docs. However, with mobility being the new trend, the limited access to the iCloud drive from only Apple devices is not serving it well enough.

Additional Storage:

There is no option for expanding your storage space for free of cost in iCloud Drive.

Paid Subscription Plans:

You can pay a dollar per month for 20 GB, \$4 per month for 200 GB or \$10 per month for 1 TB of storage.

Unfortunately, there is no business version of iCloud Drive as yet. The file sync capabilities of iCloud Drive are also not as smooth as those of Google Drive or Dropbox, for example.



Box

Anyone looking for a cloud storage option well-suited for professional users can find most of the desirables in a single place with Box. It offers 10 GB of free cloud data storage service with a cap of 250 MB in terms of file size, but that's not all, it lets users collaborate and share seamlessly on the cloud, making it a perfect fit for business users. An entire team can collaborate easily on the Box, creating and editing files in a hassle-free manner.

There is more. Privacy controls are quite good and allow users to set specific access and restrictions while sharing data with other users. Individual files can be password-protected and folders can also be shared for a limited period, if needed, with options available for setting an expiration date for sharing a specific folder.

Additional Storage:

There are no free cloud data storage service expansion plans in Box.

Paid Subscription Plans:

For \$10 per month, users can get 100 GB of storage with a file size limit of 5 GB, which is apparently good enough for even professional purposes.



Amazon Cloud Drive:

Not many people know that cloud computing is a big business for Amazon but Cloud Drive offers rather limited cloud data storage service options, one must say. We say this because Amazon Cloud Drive is really good enough only for storing photos and videos because even if you store document files including Word, PDF or XLS formats, it won't open on mobile devices.

In terms of storage, 5GB of free space is offered in which photos and videos can be shared easily by turning on camera rollback on Fire tablets or phones.

Amazon's Storage Plans:

Speaking of Amazon's cloud offerings, it must be kept in mind that in March 2015, the company announced two new plans called Unlimited Photos and Unlimited Everything. Both these plans primarily offer three-month trial versions which can be continued by paying \$12 per year for Unlimited Photos and \$60 per year for Unlimited Everything. However, if you are an Amazon Prime member or own a Fire tablet or phone, Unlimited Photos can be availed for free.

It would be important to clarify that Unlimited Photos offers unlimited storage for photos plus 5GB of storage for videos and all other types of

files whereas Unlimited Everything offers just that, unlimited storage for photos, videos and all other types of files. In terms of file sync, Amazon Cloud Drive may not be the best but offers value-for-money service with Desktop apps for Windows PC and Mac as well as mobile apps for Android and iOS platforms, making it a reasonably good cloud data storage service. However, the best advantages are reserved for those with Amazon Prime membership or having one of those sleek Fire devices.



Module 3

Most Common Uses of Cloud Computing

Cloud computing has been credited with increasing competitiveness through cost reduction, greater flexibility, elasticity and optimal resource utilization. Here are a few situations where cloud computing is used to enhance the ability to achieve business goals.

1. Infrastructure-as-a-Service (IaaS) and Platform-as-a-Service (PaaS)

Infrastructure-as-a-Service (IaaS) delivers fundamental compute, network, and storage resources to consumers on-demand, over the internet, and on a pay-as-you-go basis. Using an existing infrastructure on a pay-per-use scheme seems to be an obvious choice for companies saving on the cost of investing to acquire, manage, and maintain an IT infrastructure.

Platform-as-a-Service (PaaS) provides customers a complete platform—hardware, software, and infrastructure—for developing, running, and managing applications without the cost, complexity, and inflexibility of building and maintaining that platform on-premises. Organizations may turn to PaaS for the same reasons they look to IaaS, while also seeking to increase the speed of development on a ready-to-use platform to deploy applications.

2. Hybrid cloud and multicloud

Hybrid cloud is a computing environment that connects a company's on-premises private cloud services and third-party public cloud into a single, flexible infrastructure for running the organization's applications and workloads. This unique mix of public and private cloud resources provides an organization the luxury of selecting optimal cloud for each application or workload and moving workloads freely between the two clouds as circumstances change. Technical and business objectives are fulfilled more effectively and cost-efficiently than could be with public or private cloud alone.

The video "Hybrid Cloud Explained" provides a more in-depth discussion of the computing environment:

Multicloud takes things a step further and allows you to use two or more clouds from different cloud providers. This can be any mix of Infrastructure, Platform, or Software as a Service (IaaS, PaaS, or SaaS). With multicloud, you can decide which workload is best suited to which cloud based on your unique requirements, and you are also able to avoid vendor lock-in.

3. Test and development

One of the best scenarios for the use of a cloud is a test and development environment. This entails securing a budget, and setting up your environment through physical assets, significant manpower, and time. Then comes the installation and configuration of your platform. All this can often extend the time it takes for a project to be completed and stretch your milestones.

With cloud computing, there are now readily available environments tailored for your needs at your fingertips. This often combines, but is not limited to, automated provisioning of physical and virtualized resources.

4. Big data analytics

One of the aspects offered by leveraging cloud computing is the ability to use big data analytics to tap into vast quantities of both structured and unstructured data to harness the benefit of extracting business value.

Retailers and suppliers are now extracting information derived from consumers' buying patterns to target their advertising and marketing campaigns to a particular segment of the population. Social networking platforms are now providing the basis for analytics on behavioural patterns that organizations are using to derive meaningful information.

5. Cloud storage

Cloud can offer you the possibility of storing your files and accessing, storing, and retrieving them from any web-enabled interface. The web services interfaces are usually simple. At any time and place, you have high availability, speed, scalability, and security for your environment. In this scenario, organizations are only paying for the amount of cloud storage they are actually consuming, and do so without the worries of overseeing the daily maintenance of the storage infrastructure.

There is also the possibility to store the data either on- or off-premises depending on the regulatory compliance requirements. Data is stored in virtualized pools of storage hosted by a third party based on the customer specification requirements.

6. Disaster recovery

Yet another benefit derived from using cloud is the cost-effectiveness of a disaster recovery (DR) solution that provides for faster recovery from a mesh of different physical locations at a much lower cost than the traditional DR site with fixed assets, rigid procedures and a much higher cost.

7. Data backup

Backing up data has always been a complex and time-consuming operation. This included maintaining a set of tapes or drives, manually collecting them, and dispatching them to a backup facility with all the inherent problems that might happen in between the originating and the backup site. This way of ensuring a backup is performed is not immune to problems (such as running out of backup media), and there is also the time it takes to load the backup devices for a restore operation, which takes time and is prone to malfunctions and human errors.

Cloud-based backup, while not being the panacea, is certainly a far cry from what it used to be. You can now automatically dispatch data to any location across the wire with the assurance that neither security, availability nor capacity are issues.

While the list of the above uses of cloud computing is not exhaustive, it certainly gives an incentive to use the cloud when comparing to more traditional alternatives to increase IT infrastructure flexibility, as well as leverage on big data analytics and mobile computing.

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.

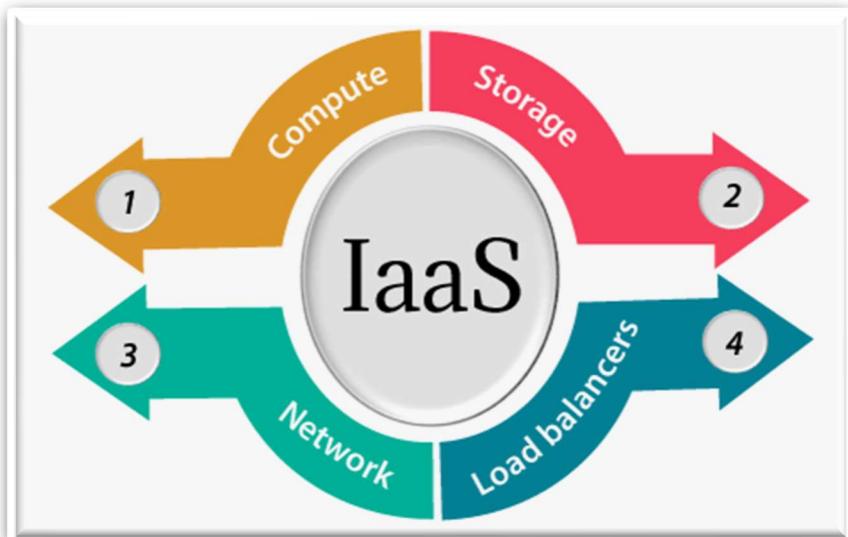
In traditional hosting services, IT infrastructure was rented out for a specific period of time, with pre-determined hardware configuration. The client paid for the configuration and time, regardless of the actual use. With the help of the IaaS cloud computing platform layer, clients can dynamically 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 upgrading 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

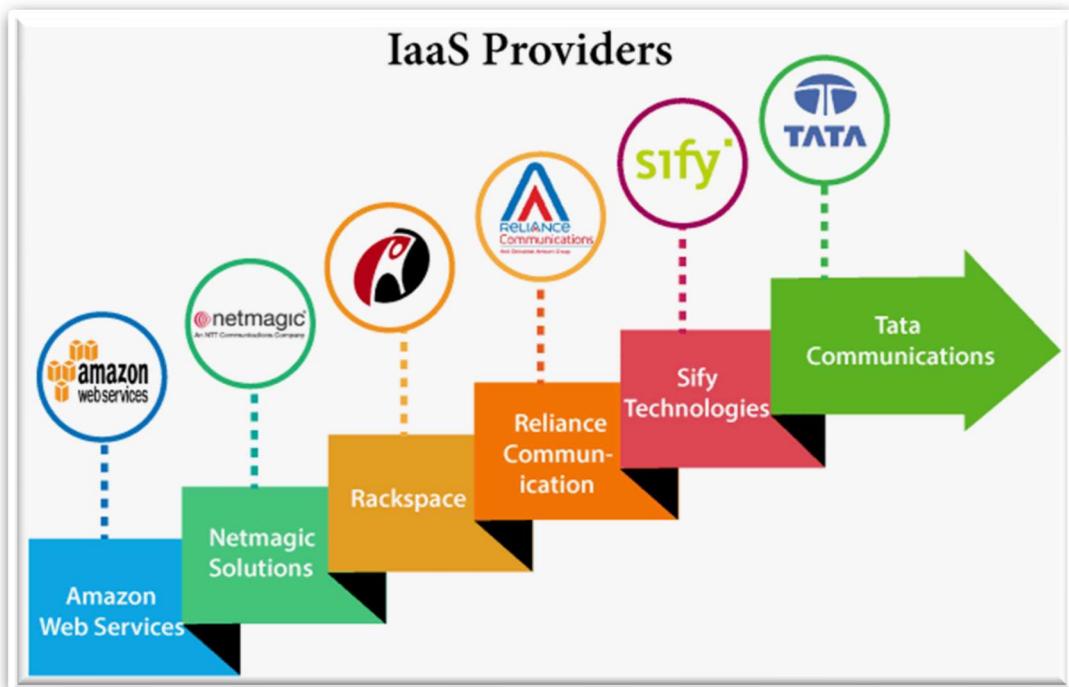
IaaS cloud computing platform cannot replace the traditional hosting method, but it provides more than that, and each resource which are used are predictable as per the usage.

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.

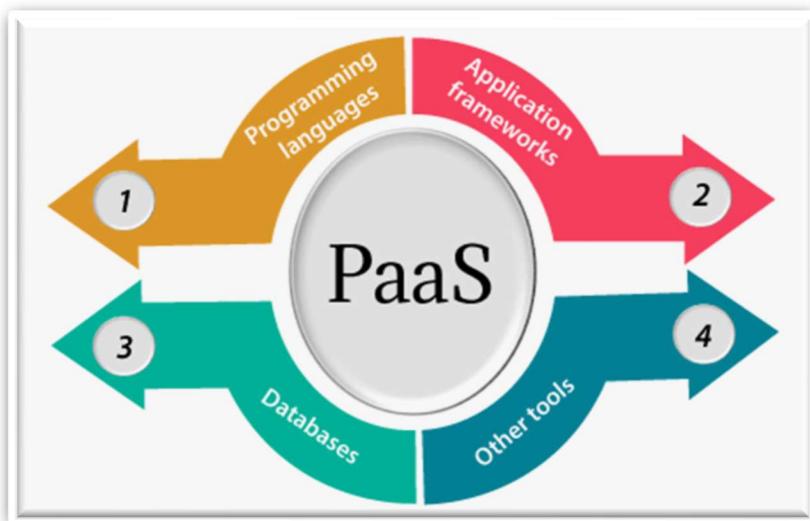
Platform as a Service | PaaS

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 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

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

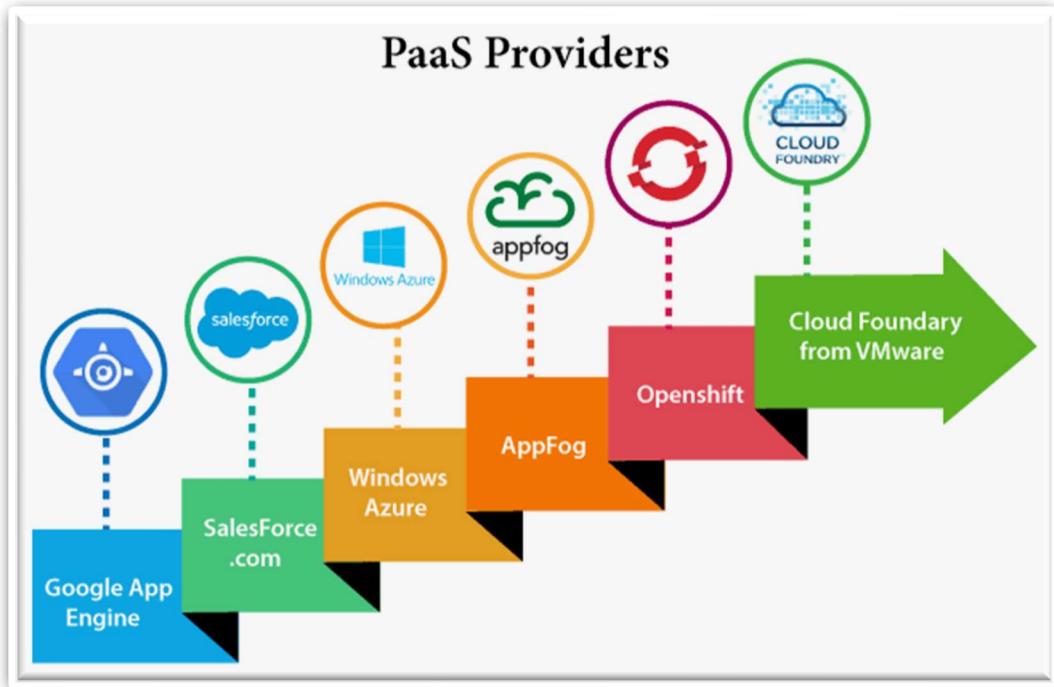
2. Data Privacy

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.



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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

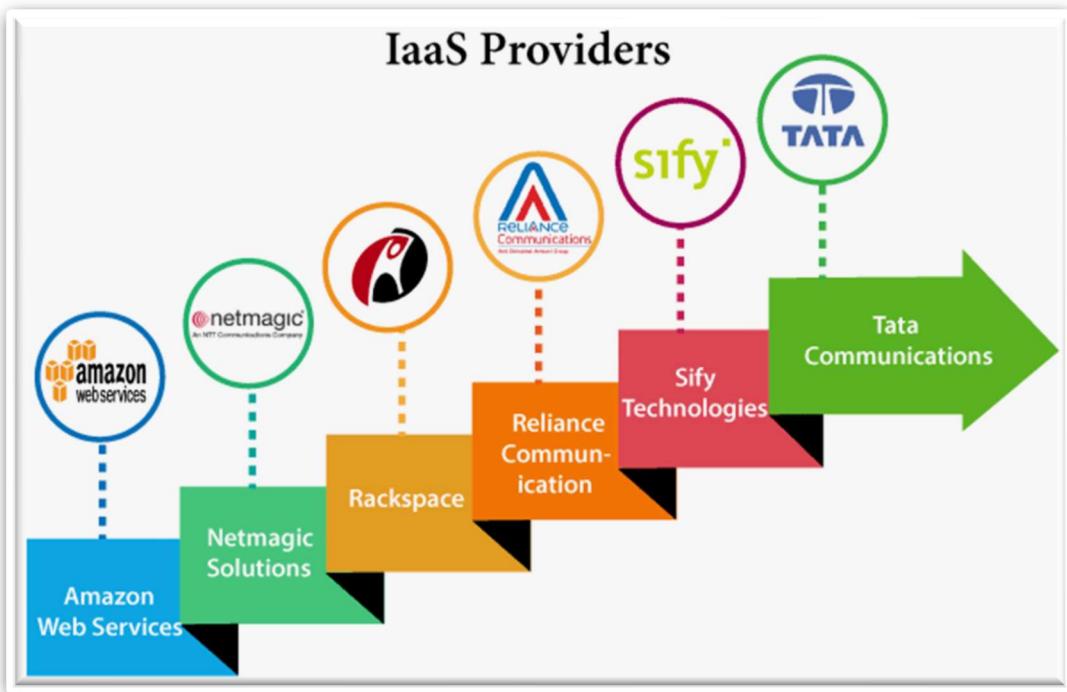
IaaS cloud computing platform cannot replace the traditional hosting method, but it provides more than that, and each resource which are used are predictable as per the usage.

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.

Cloud Computing Trends

In the business world, there are few technologies that have had a greater impact than **Cloud Computing**. In this article, 7 new Cloud Computing trends for the future.

According to a 2018 [study by Gartner](#), **cloud users will double by 2021**; at the same time, the market built around this technology will grow from **\$153 billion in 2017 to an estimated \$302 billion by 2021**. According to [Gartner](#), by 2022, about **90% of organizations will use “cloud” services** (according to another study). Moreover, already today, Cloud Computing skills are the most requested by companies in every sector according to [research from LinkedIn](#).

There are many reasons for the overwhelming success of this technology.

Relying on a service provider in the cloud, in on-demand mode, reduces costs, from those related to the purchase of one or more local servers (with the related costs for management and maintenance) to those for software and cyber-security.

Then, there are the advantages of flexibility and scalability which Cloud Computing systems can guarantee for most any type of company, from established organizations, to growing start-ups that scale up data collection and operations over just a few months.

And, let's not forget fundamental issues like **security and reliability**. The best cloud providers offer fundamental guarantees on these sensitive issues. In this [post](#) we focused on the main benefits offered by Cloud Computing systems. Now, we want to look ahead. In this post, we'll be looking at the seven main Cloud Computing trends on the horizon.

1. Hybrid and Multi-Cloud

What is the Hybrid Cloud? Without getting too technical, the hybrid cloud is a Cloud Computing environment that exploits both public and private clouds as well as some third-party tools. In this way, the logic of on-demand, pay-per-use, and Software as a Service (SaaS) are exploited simultaneously, all in an enhanced way.

The result is absolutely dynamic, scalable, and flexible machine and resource management. Even more importantly, the hybrid system lends itself to great opportunities for “personalization.” Each company programs its ideal combination, as personalized as possible and built “to measure,” according to its characteristics and needs (see trend 6 for more on personalization).

Of course, this has a positive impact on performance. It's no wonder, then, that the use of Hybrid Cloud solutions has increased by 7% in a single year, from 2018 to 2019 (source: RightScale). In addition, 58% of companies now have a hybrid cloud computing strategy (also according to RightScale).

The Multi-cloud is something very similar to the Hybrid: it is the use of different Cloud Computing and data storage systems within a single IT architecture. There can be multi-cloud systems based only on public systems, only on private systems or, finally, on a combination of hybrid systems.

2. Serverless

“Serverless,” also known as, FaaS (Function as a Service) is one of the main Cloud Computing trends.

First of all, don't be fooled by the name: one or more servers for processing operations are always essential, upstream of everything. The real innovation of these systems is the possibility to run applications without worrying about the underlying infrastructure. Translated: provisioning, scalability, and server management are automatically administered, with enormous advantages for flexibility and performance.

The first serverless model was released by Amazon in 2014 (known as AWS Lambda); Microsoft, IBM, and Google soon followed with their own serverless offerings. Serverless solutions were used by 21% of companies in 2018. Compared to the previous year, serverless grew about 75% (source).

3. New Backup and Disaster Recovery Systems

One of the most important advantages of Cloud Computing is the efficiency and elasticity of the Backup and Disaster Recovery systems (a term used to identify all recovery measures relating to data, systems or infrastructures).

According to a recent Spiceworks report, 15% of the cloud budget is invested in improving this fundamental aspect.

That's why all major cloud service providers (public, private or hybrid) are working hard on this front.

4. Big Data and Artificial Intelligence

Combining Cloud Computing and Big Data analysis brings enormous benefits and enhances the effectiveness of both technologies.

In this sense, we understand the importance of implementing Artificial Intelligence systems to better interpret the enormous and varied amount of data useful for improving all business processes (both those aimed “inside” the organization, as well as outside facing processes, from marketing to purchasing departments, to sales and Customer Service).

The combination of Cloud Computing, collection of Big Data and subsequent interpretation through Artificial Intelligence systems must be studied carefully and above all must be calibrated to measure, depending on the needs of the individual company, and its objectives.

5. IoT (Internet of Things)

Having “objects” connected to the network allows you to place a large amount of data, often very precise and significant (and until recently unavailable), in the cloud.

IoT technologies related to Cloud Computing can, for example, be very useful for monitoring a company’s production processes to detect inefficiencies and study solutions for improvement.

But that’s not all: the Internet of Things can also prove valuable in relationships with users; think about how much data can be collected by companies in the Utility Industry through counters connected to the network. This is data that is useful for companies, but also for customers themselves. All of this translates into a potential increase in revenue, but also in an improvement in customer loyalty. And this is just to give an example.

6. Cybersecurity

As the adoption of Cloud Computing systems increases, so do security issues.

This is both an essential and delicate point that requires the utmost attention (both from providers and from companies that use their systems). With the introduction of GDPR (General Data Protection Regulation) in the European Union, cybersecurity has become even more urgent. This is no small matter.

According to a recent Commvault survey, for example, only 12% of IT organizations really understand how GDPR will affect their cloud services. Again, there is a clear need to rely on professional Cloud Computing service providers who are up to date with the latest regulations, software updates, and security features.

7. Everything will revolve, more and more, around personalization

Cloud computing almost naturally leads to personalization, on all fronts. Personalization will be one of the main Cloud Computing trends in the next future.

Upstream, there is the possibility of building a software and infrastructure ecosystem that is closely tailored to the individual company (and that can vary over time, adapting to new needs). This is a possibility that becomes even more important in Hybrid Cloud and Multi-Cloud systems.

Further downstream, however, there is the possibility of exploiting the cloud to collect as much data as possible (as we have seen above, in point 4); but, above all, significant data (the so-called “Deep Data” or “Smart Data”), useful for bringing personalization all contact operations with customers, from marketing to Customer Communication.

Module 4

Cloud collaboration

Cloud collaboration is a team collaboration method where colleagues can work together on documents housed in the cloud, with everyone able to access the same files and edit them in real-time.

Team members can view and edit the documents at any time, from any location – including when they are working simultaneously. Edits are visible to all team members as they are made, and changes are saved and synced so that every user sees the same version of the project.

Cloud collaboration eliminates the confusion caused by having multiple versions of the same documents or the trials of attempting to merge resulting files.

The rapid growth of cloud computing services and collaboration technologies has obvious benefits for remote and hybrid workforces. It enables teams to work together and achieve their shared goals without being together physically in the workplace.



Benefits of cloud collaboration

Cloud collaboration helps to build a sense of community through teamwork, increases productivity and stimulates creativity.

Using this method makes it easier to make the transition to a remote workforce. That's thanks to the associated benefits of reducing company overheads, minimising the environmental impact of commuting, and improving employees' work-life balance.

Streamlines organisation workflow

Cloud collaboration improves **productivity** by helping teams work faster and more efficiently. It's also perfect for flexible work scheduling since tasks can be shared between collaborators with varying working hours and colleagues in different time zones.

Using cloud storage means everyone has easy access to all the documents they need, and they can share files from wherever they are, at any time. This reduces the amount of time spent waiting for information and decisions. Plus, there's no need to send updated versions to the relevant co-workers.

Improved communication and participation

Communication is vital to successful projects, especially in a distributed workforce. Cloud collaboration allows for a higher degree of employee participation, as the 24/7 accessibility of files gives all team members an equal opportunity to provide input.

Cloud-based collaboration tools also enable colleagues to communicate with one another while working simultaneously. As well as seeing who else is viewing the document, they can use **real-time annotation**, group chat and instant messaging functions.

Accessibility to files

The big bonus of a cloud platform is its accessibility. File sharing and editing are simple, whether a worker is in the office, at home or out on the road.

Cloud solutions also allow large files to be stored and shared with ease. Video and audio files are increasingly used in business, yet most email servers cannot handle documents larger than a few megabytes. This can cause delays and a disrupted workflow.

Of course, the cloud also reduces worries about losing important documents and data through mistakes or breaches. Files are automatically backed up and are retrievable in the event of a disaster.

Real-time updates

When a document is edited or updated, the changes appear real-time and can be accessed by everyone. There's no such thing as the "latest version"; there's just one version, with all team members working on it.

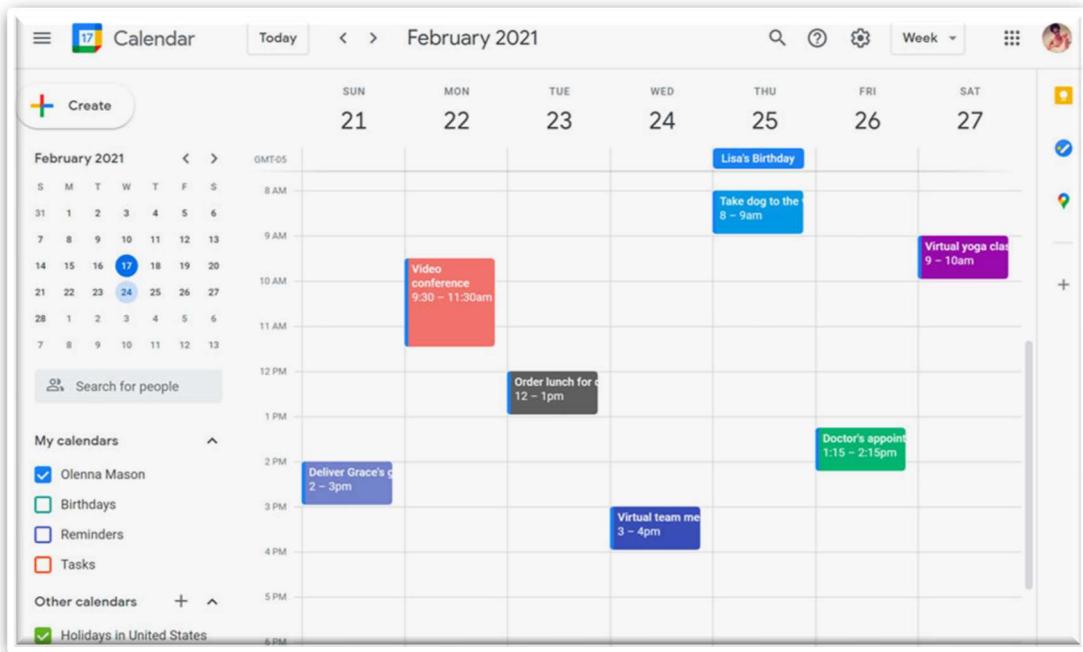
Collaboration platforms have a system whereby an alert is sent to all participants whenever the file is changed to make things even easier. This helps keep everyone on top of new developments and ensures that colleagues are literally on the same page.

Better brainstorming

Brainstorming is great for boosting creativity and innovation, but it can be tricky when it is spread across the country or even the world. However, the ease of communication within cloud collaboration software means that team members can instantly share their ideas via real-time comments, chat, or **video conferencing**.

Google Calendar

The most popular web-based calendar today, no doubt due to its association with the web's most-used search engine, is Google Calendar (calendar.google.com). Google Calendar is free, full featured, and easy to use. It lets you create both personal and shared calendars, which makes it ideal for tracking business group, family, and community schedules.



Google Calendar looks pretty much like every other calendar you've ever seen. You enter your appointments (which Google calls “events”) directly into the calendar, which you can display in either daily, weekly, or monthly views. You can also, if you like, view your weekly agenda on a single page

Like all web-based calendars, all your events are stored in the cloud (in this case, the cloud created by Google's own network of servers), not on your own computer. This means that you can access your calendar from any computer anywhere in the world. Just log in to the Google Calendar page and your calendar and all events are there. Because Google Calendar is web based, you can use it to create not only a private calendar for yourself, but also public calendars for your company or organization. Create a public calendar and all employees or attendees can access it via the web. In addition, special event invitation features make it easy to invite others to an event—public or private. In addition, Google allows you to create several different—and different types of—calendars. You can create one calendar for home, another for work, and yet another for your son's soccer team. Then you can view all your calendars from the same Google Calendar page, with the events from each calendar color-coded for easy visibility

What types of calendars can you create with Google Calendar? Here's the list:

- Personal calendars, like your default calendar
- Public calendars, which others can access via the web
- Friends' calendars, which you import from their Google Calendar web pages
- Holiday calendars, which add national holidays to a basic calendar

Setting up a new calendar is comically easy. In fact, there's nothing to set up. When you first sign into the Google Calendar page, your calendar is already there, waiting for your input. There's nothing to create, nothing to configure. Can it get any easier than that? And here's something unique about Google Calendar. Because it's part of the mighty Google empire, Google Calendar integrates smoothly with Google's Gmail application. Google Calendar can scan your email messages for dates and times and, with a few clicks of your mouse, create events based on the content of your Gmail messages. For all these reasons, I'm a big fan and long-time user of Google Calendar. I recommend it to any user for home or business use.

Cloud-Based Project Management

What is cloud-based project management?

A cloud-based project management software coordinates the planning, collaborating, monitoring, and delivering of a project. It allows project managers and teams to get work done using a network of tools available within the software, rather than using a plain old whiteboard and sticky notes. The use of project management software scales from business to business—and team to team. But, in all, it is designed to make managing projects and deadlines easier and more effective.

What are the advantages of a cloud-based project management tool?

Cloud-based solutions have been a dominant trend in the business industry for the last few years. New and improved software solutions have been entering the market on a regular basis, making it difficult for organizations to find the right tool. But before you start looking for a project management tool, it's important to explore the many advantages a cloud-based project management solution has to offer.

Speaking of which—Here are the benefits of using project management software for your business.

Benefits of using cloud-based project management software for your business

1. Easy access

First and foremost, cloud-based project management software allows you to access the information from any part of the world, provided you have an internet connection. Also, you can access content from multiple devices – mobile phone, laptop or tablet. Whether you are in a meeting room, a conference room or at living room in your house – you can have access to all your information right at your fingertips. It successfully eliminates any requirement to be linked to a particular server at your workplace or any specific platform (Windows, Mac, Linux etc). Thus, it provides a lot of flexibility and ease in accessing information from anywhere in the world.

2. Easy to get started with

The best part of having a cloud-based project management tool is the ease it provides the people to get started with it. It does not require any rigorous training, knowledge of extra tools or installations. Unlike conventional methods, which would require you to have specific training about that tool, these software are designed to be used in the most simplest ways. You can link it with any of your social media handles and you are good to go.

3. Highly cost-effective

These cloud-based management software are very easy on your pocket. You don't need to spend millions on buying servers, additional installations or buying additional storage. Additionally, most of them provide high-standard customer experience and technical support to the buyers. Thus, it is highly cost-effective making it a technology worth investing in.

4. Improved collaboration and productivity

Online cloud-based project management tools are designed to improve collaboration by ending email volleyballing at workplace. These provide a centralized place for communication and document sharing which results in high productivity for every team member without any financial costs. For instance, ProofHub a task management software provides a collaborative platform for effective communication and document. Thus, these tools create many avenues for improved collaboration and better productivity at work.

5. No additional installations and hardware

One of the many advantages these tools offer is that they do not require any hardware nor any additional installations. Unlike old-school technologies where you need to buy additional licenses for every computer with new settings. Cloud-based PM tool eliminates the need of this completely. Additionally, the vendor that allows you to have access of this cloud-related project management tool in a complete hassle-free manner.

6. Low maintenance technology

Cloud-based **project management systems** being highly cost-effective are also low on maintenance. You don't need an army of IT people running here and there solving tackling software related challenges. Moreover, the vendors take care of any issues or requirements such as version upgrades and anomalies in the online cloud-based project management software.

7. Reliable and secure

All cloud-based **project management software (like ProofHub)** are made with world-class technologies and undergo several security measures. Thus, these

software are very reliable and secure. There are several mechanisms such as data segregation, SSL certificates that are employed by vendors to secure customer's data. Even if your laptop gets stolen or lost, you just need to login from your online account and change the password to protect your data.

8. Free monthly trials

About 99.9% of the online cloud-based project management software vendors provide free 30 day trial for the product. It gives the buyer an opportunity to test the features, understand its working and to judge if the tool is a right fit for them or not. Getting a free trial doesn't hurt, right? So, make sure you try the software properly before investing in it.

9. Allows web-based integrations

To run a business effectively, one has to take help from the number of applications and services. So, it becomes a necessity for the cloud-based project management tool to allow various web-based integrations at one centralized place. It allows users to manage a plethora of tasks and services simultaneously at one place. This, consequently, helps in saving a lot of time and improving productivity.

10. Support for remote teams

Today, more and more organizations are rooting for cross-functional and decentralized teams. They are building teams with a combination of local, remote and overseas talents. In order to make these teams work, each team member should be able to collaborate, share information, and access critical documents whenever and wherever they need to. That's what cloud-based project management solutions are designed to help with. One of the critical benefits of using a project management tool is that it enables teams to become more mobile and remote.

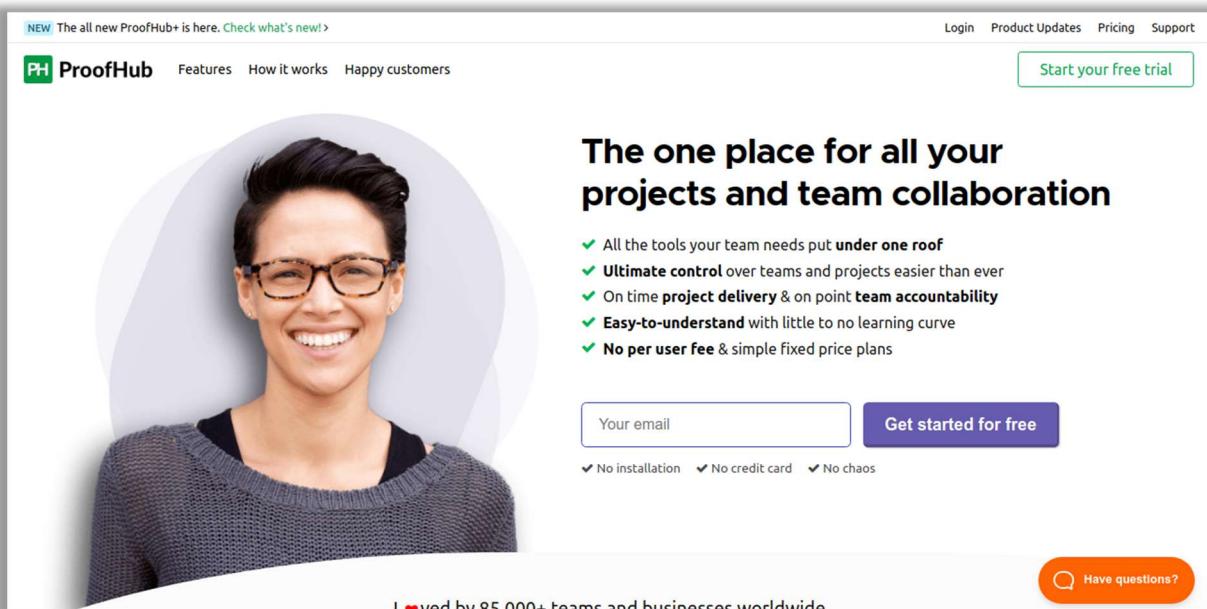
11. Super time saver

Being able to visualize the overall timeline for the completion of a project or deliverable is an important aspect of the project management process. With the help of a project management software, managers and teams can not only visualize or evaluate the project timeline, but they can also track the exact amount of time that needs to be spent (or has been spent) on a specific task, milestone, or project. Doing this makes it easier for everyone on the team to get a clear understanding of how long each task will take, how each task groups together, and what they can do to cut down the delivery time, thereby finding ways to save tons of time.

Which is the best cloud-based project management software?

Choosing the right project management software can often become a pain in the neck, especially when there are so many options to choose from. However, selecting the right project management software is important. The right tool enables communication, organizes the organization's workload, and more importantly, it impacts the project success. Keeping that in mind, we've compiled a list of the best project management software that you might want to check out.

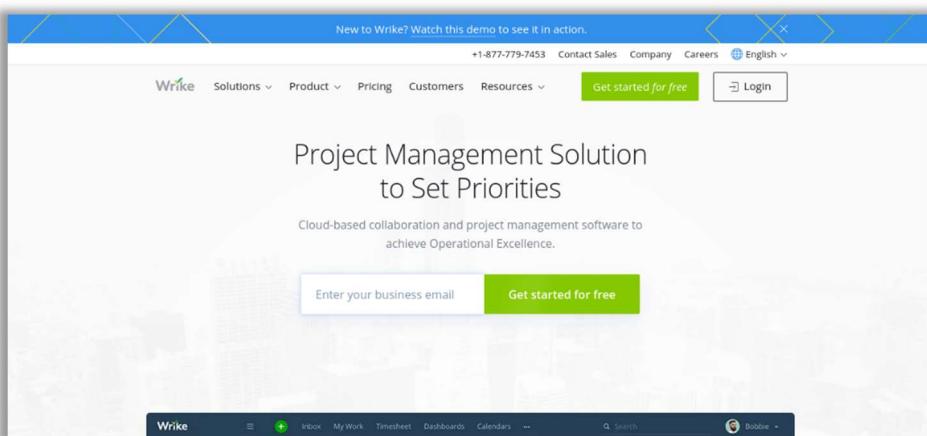
ProofHub



The screenshot shows the ProofHub homepage. At the top, there's a banner with the text "NEW The all new ProofHub+ is here. Check what's new!" and links for "Login", "Product Updates", "Pricing", and "Support". Below the banner is the ProofHub logo and navigation links for "Features", "How it works", and "Happy customers". A prominent feature is a large circular portrait of a smiling woman wearing glasses and a grey sweater. To the right of the portrait, the headline reads "The one place for all your projects and team collaboration". Below this are five bullet points highlighting features: "All the tools your team needs put under one roof", "Ultimate control over teams and projects easier than ever", "On time project delivery & on point team accountability", "Easy-to-understand with little to no learning curve", and "No per user fee & simple fixed price plans". There are input fields for "Your email" and a "Get started for free" button. Below these are three small checkboxes: "No installation", "No credit card", and "No chaos". At the bottom, a callout says "Loved by 85,000+ teams and businesses worldwide" and a "Have questions?" button.

ProofHub is a made-for-all solution. From freelancers to multinational enterprises from different business verticals – ProofHub is a project management and collaboration software that conveniently fits within any corporate setup. The software comes with integrated one-on-one/group chat, quick Discussions, Workflows, and Kanban boards, custom reports, custom roles, centralized files, notes, Gantt charts, proofing, timesheets, timers, and many more powerful features. The purpose of ProofHub is to enable teams to collaborate over projects in an easy, diverse manner and get them delivered as scheduled.

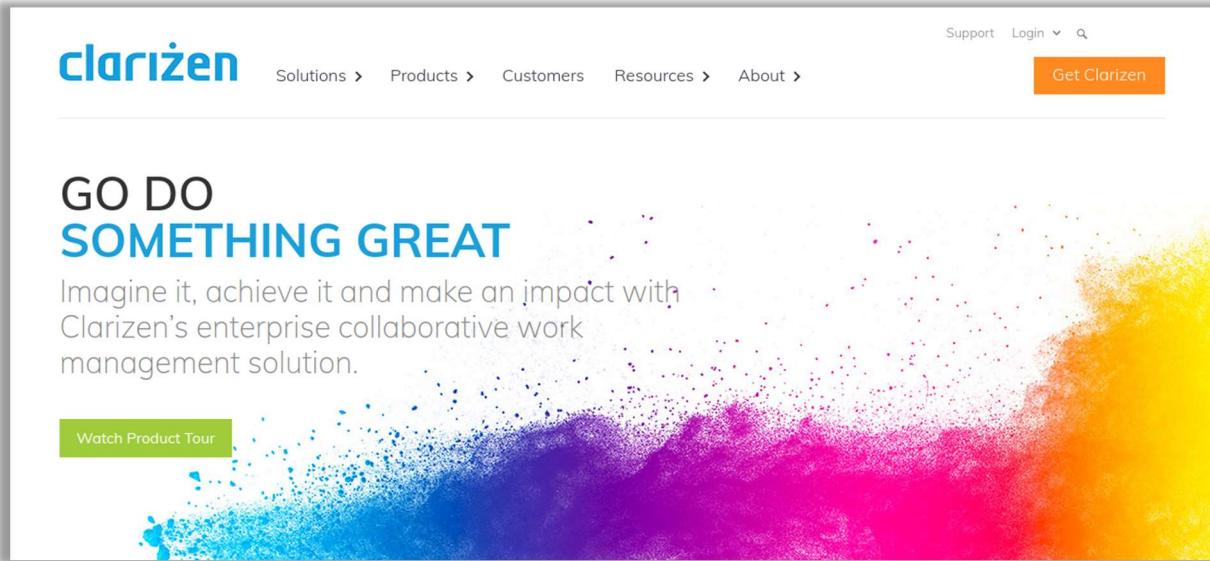
2. Wrike



The screenshot shows the Wrike homepage. At the top, there's a blue header bar with the text "New to Wrike? Watch this demo to see it in action.", phone number "+1-877-779-7453", and links for "Contact Sales", "Company", "Careers", and "English". Below the header is the Wrike logo and navigation links for "Solutions", "Product", "Pricing", "Customers", and "Resources". A green "Get started for free" button is located next to the "Login" button. The main content area features the headline "Project Management Solution to Set Priorities" and a subtext "Cloud-based collaboration and project management software to achieve Operational Excellence.". There are input fields for "Enter your business email" and a "Get started for free" button. At the bottom, there's a navigation bar with links for "Inbox", "My Work", "Timesheet", "Dashboards", "Calendars", "Search", and a user profile for "Bobbie".

Wrike is a project management tool with a load of useful features like task management, task prioritization, real-time newsfeed, interactive timeline (Gantt chart), and workload management. It works for both distributed and co-located teams. With Wrike, teams can easily schedule, discuss, and prioritize their tasks, and track projects as they progress. Wrike's Paid packages start from \$9.80/user/month (annual billing) for the Professional plan.

3. Clarizen

The screenshot shows the Clarizen website homepage. At the top, there is a navigation bar with links for Support, Login, and a search icon. The main header features the Clarizen logo in blue. Below the header, a large banner with a colorful, abstract background has the text "GO DO SOMETHING GREAT" in bold blue letters. A subtext below it reads: "Imagine it, achieve it and make an impact with Clarizen's enterprise collaborative work management solution." A green button labeled "Watch Product Tour" is visible on the left side of the banner. The overall design is modern and professional.

Support Login

clarizen

Solutions > Products > Customers Resources > About >

Get Clarizen

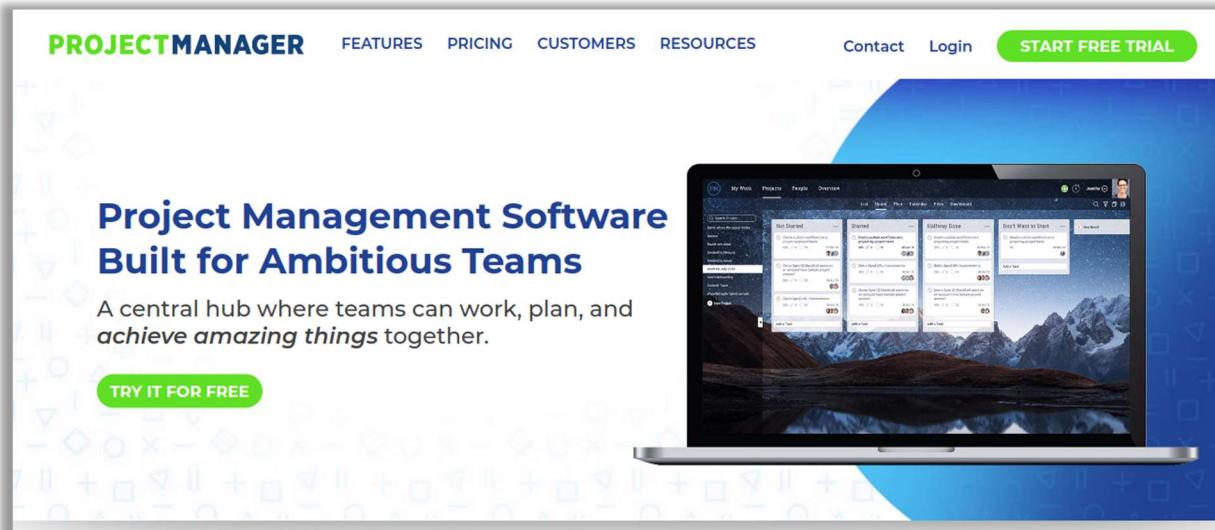
GO DO SOMETHING GREAT

Imagine it, achieve it and make an impact with Clarizen's enterprise collaborative work management solution.

Watch Product Tour

Clarizen is a project management software with a key focus on social engagement. It is designed to automatically prioritize projects, tasks, resources, budgets, and portfolios so that key resources and information are managed appropriately during the project management process. Other than that, templates, personal calendars, project portfolio management, workflows, dashboards, approval processes, and version control are some important features that make Clarizen a part of our top 5 project management tools. Clarizen offers two priced editions – Clarizen's Enterprise plan starts at \$45/user/month and Clarizen's Unlimited plan starts at \$60/user/month.

4. ProjectManager

The screenshot shows the ProjectManager website homepage. At the top, there is a navigation bar with links for FEATURES, PRICING, CUSTOMERS, and RESOURCES, along with Contact and Login buttons, and a prominent "START FREE TRIAL" button. The main headline is "Project Management Software Built for Ambitious Teams". Below the headline, a subtext reads: "A central hub where teams can work, plan, and achieve amazing things together." A green "TRY IT FOR FREE" button is located at the bottom left. On the right side, there is a large image of a laptop screen displaying the ProjectManager software interface, which includes various project management tools and dashboards. The overall design is clean and professional.

PROJECTMANAGER

FEATURES PRICING CUSTOMERS RESOURCES

Contact Login START FREE TRIAL

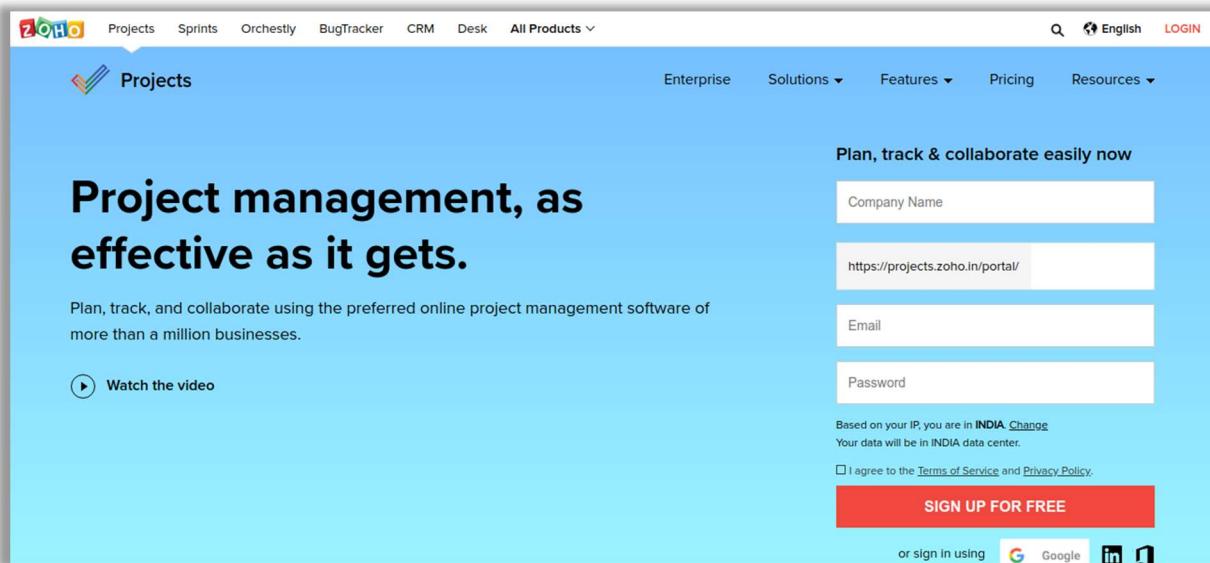
Project Management Software
Built for Ambitious Teams

A central hub where teams can work, plan, and achieve amazing things together.

TRY IT FOR FREE

Project Manager is a tool designed to elevate efficiency in project planning, budgeting, scheduling, execution, and reporting. It is one of the most trusted project management systems in the market today. The platform essentially focuses on the three major parts of a project management process—planning, monitoring, and reporting. Additionally, it offers advanced add-on features like real-time dashboards, automated emails, and quick report generation. If this interests you, then you can easily sign up for ProjectManager's free trial.

5. Zoho Projects



Zoho Projects is a cloud-based project management platform designed to make your business projects more productive. The platform comes equipped with features that help to improve collaboration, facilitate monitoring, and enhance productivity and overall quality of the output. With Zoho Projects, teams can get work done and delivered on time. Zoho Projects pricing scheme is quite flexible. It comes with five plans, with a free plan for freelancers and small teams.

Thus, cloud-based PM softwares are ground-breaking with the power to fast-track any organization onto the path of success. In today's fast-changing business environment, cloud-based software are revolutionizing the traditional workplace. Thus, these software stands undeniably tall in fostering world-class collaboration and improved productivity at the workplace. They indeed have become an indispensable prerequisite at workplace to achieve tremendous success.

Thus, it's high time for businesses to come under the cloud technology. If you are ready to take the leap. Start your free trial with ProofHub now and reap all the above-mentioned benefits.

Module 5

Case study on Microsoft Azure

What Is Microsoft Azure?

Microsoft Azure is a Microsoft cloud service provider that provides cloud computing services like computation, storage, security and many other domains. Microsoft is one of the global leaders when it comes to Cloud solutions and global cloud infrastructure. Microsoft Azure provides services in 60+ global regions and serves in 140 countries. It provides services in the form of Infrastructure as a service, Platform as a Service and Software as a service. It even provides serverless computing meaning, you just put your code and all your backend activities as managed by Microsoft Azure.

It easily integrates with Microsoft Products making it very popular using Microsoft products. This platform is now 10 years old and it picked up to compete with the best of the best.

Benefits of Microsoft Azure

Microsoft Azure may be considered second to Amazon Web Services in few features, but it has quite a few that make it stand tall on its own. Let us take a look at them, one by one

On-Demand Scalability

When we talk of Application Hosting we can never be sure of how many resources are enough and how many are too much. This is the nature of businesses that rely on varying traffics. What it does is forces businesses to plan a lot and invest a lot of money doing it. Microsoft Azure helps you save all this effort.

Microsoft Azure ensures your applications and data is distributed well enough that means you never run short of Server space. It also means your applications do not run on a single server making them available even in dire situations. Since these resources are properly clustered out and they can scale at will and in no time, your applications function very differently than they would in an on-premise architecture.

Cost Effective

One of the major benefits with cloud service providers is the cut down of upfront costs. Since you can configure and scale at will, you are not required to invest heavily here. Microsoft Azure ensures small scale investment does not require upfront costs. Also when it comes to people who have signed up contracts, they get heavy discounts. It also offers to Pay as go, model, meaning you get cost-cutting in the right sense.

Hybrid Environments

They say cloud is not a one fit solution for all. It is true indeed because every business will have its own set of problems. And not all businesses will always be in a state where they can migrate to the cloud entirely. While other platforms suffer here, as people either have to migrate to those platforms or call it off totally, Microsoft Azure benefits with its Hybrid approach. Meaning, with Microsoft Azure you can build Hybrid infrastructures, where your resources can partially reside on the cloud and can partially operate from an on-premise infrastructure. Hence you are safe from costly workaround.

Big data Applications

Hadoop and Big data are the need of the hour. With data increasing exponentially we need applications that can help process this data. Microsoft Azure brings this capability of processing large volumes of data on top of its cloud platform. Azure HDInsight ensures you can use Apache Hadoop as a cloud solution. This is a power-packed service that lets you deal with large data volumes. That means your data crunching becomes easier.

It also readily integrates with data visualization tools and also lets you move your data to excel. This means your data visualization concerns are resolved quickly. With excel you can create visualizations and with PowerBI integrating with Microsoft Azure your data be converted into any visual that you require.

Integration Capabilities

Microsoft has been in the software industry for decades. It has wide reach in the software market and not many can compete with it when it comes to customer base and stack of products it offers. The advantage for Microsoft Azure here is that it readily integrates with most of these products. Be it, connecting to SaaS, PaaS, IaaS applications or even something like Visual Studio or Active Directory, Microsoft Azure has you covered. Hence you can now leverage ERPs and CRMs to enhance your business capacity to a greater level.

So should you be worrying if you do not use Microsoft Products. The answer is ‘NO’. You can even connect to or integrate many third party applications and services to widen your business reach.

Storage and Security

Storage is very critical to any application. It is no different for applications running on cloud. As already discussed, the volume of data we handle these days is huge. It also comes in different formats and from different sources. Your Storage resources have to adept enough to handle this data. Microsoft Azure has you covered here as well It lets you store data in form of files, objects, structured and unstructured data and a lot more. This happens reliable and securely.

Talking of security Microsoft Azure ensures high level of security for your applications. It ensures all the resources in Azure cloud are guarded with firewalls and data is moved over the network with encryption. You have access to authentication and access management meaning your data and application are secure to the core.

Scheduling and Automation

Everyone hates doing repetitive tasks. What if we could automate mundane tasks or recurring tasks be it fetching some data, setting up triggers or scaling your resources when needed? Microsoft Azure does that for you ensuring you can utilise your workforce for more productive outcomes and get rid of stagnancy or repetition of work.

Data Backup and Recovery

Data Backup ensures you have a copy of your data maintained in case if your primary copy of data or resources is lost. With Microsoft Azure, you have an option of backing up your data in different Azure regions or data centres. You can maintain as many as six copies of your data. This signifies that the chance of losing your data on Microsoft Azure is minimal. When it comes to reliability your data is available 99.9 percent.

So this was About the benefits of Microsoft Azure. Let us go ahead see do customers have to about Microsoft Azure and what are some of the popular use cases it has to offer to us.

Use Cases of Microsoft Azure

Microsoft has many popular customers out there, here are some use cases for you,

University Of Toronto

This is the largest Canadian university and leads the global front when it comes to research at an institutional fare. It made use of Microsoft Azure to avoid heavy hardware renewal costs. It migrated some of its activities to Microsoft Azure Cloud. With it, the university managed to transform IT processes, saving a lot of time

AkzoNobel

AkzoNobel is a popular Dutch Company that leads way in paint and coating business. It serves in more than 100 countries and always needs better connectivity across the globe. It harnessed the power of Microsoft Azure IoT services to improve its performance and connectivity at a global level.

IHG (Intercontinental Hotel Group)

This is one of the largest and leading hotel groups in the world. It owns around 5200 properties across the globe and serves more than a hundred countries. The fact that you own 5200 properties tells you the group holds its values of service very truly and also must have experimented a lot to stay up to date with market needs as well. This fact is also supported by the fact that this group invests a lot of money in innovations to meet the experience quality the customers deserve.

The company has many of its tools that require Agile practices. It already was based on Azure Cloud platform. This is when they decided to use DevOps Services on Microsoft Azure. This not only helped them bring their software and data handling process on track, but also helped them fortify their security and processing principles. The fact that Microsoft Azure Supports Hybrid cloud meant big group like IHG did not have to move to Azure cloud altogether.

Ever since it has moved to Azure StorSimple, which is a hybrid storage service for enterprises. The group has achieved great results when it comes to storing data. It has helped them save more 70 percent in terms of cost. This is something that was initiated four years ago. It needed very little support in setting up and does require too much intervention when it comes to administrative attention.

Before they moved to the above-mentioned service, IHG group had to deal with multiple data and file services to gather and store data. Azure StorSimple ensured this data was consolidated and easy to manage overall. Data Backup issue was also resolved as Azure ensured that easy way to get a snapshot of data. That means data could be backed up easily and quickly.

So this was about different customers and how they used Microsoft Azure to solve their business problems. With this, we have come to the end of this article on Microsoft Azure: Benefits and Use Cases. We hope you liked this article and it has spiked your interest in learning or using Microsoft Azure. We hope you perceive your Cloud Journey further, Happy Learning!

In case you have any questions, feel free to put those in the comment section and someone from our team will respond to your queries at the earliest. You can click on the below banner to get a free course on Microsoft Azure.

Execution Environment

The Windows Azure execution environment consists of a platform for applications and services hosted within one or more roles. The types of roles you can implement in Windows Azure are:

- **Azure Compute (Web and Worker Roles).** A Windows Azure application consists of one or more hosted roles running within the Azure data centers. Typically there will be at least one Web role that is exposed for access by users of the application. The application may contain additional roles, including Worker roles that are typically used to perform background processing and support tasks for Web roles. For more detailed information see “Overview of Creating a Hosted Service for Windows Azure” at <http://technet.microsoft.com/en-au/library/gg432976.aspx> and “Building an Application that Runs in a Hosted Service” at <http://technet.microsoft.com/en-au/library/hh180152.aspx>.
- **Virtual Machine (VM role).** This role allows you to host your own custom instance of the Windows Server 2008 R2 Enterprise or Windows Server 2008 R2 Standard operating system within a Windows Azure data center. For more detailed information see “Creating Applications by Using a VM Role in Windows Azure” at <http://technet.microsoft.com/en-au/library/gg465398.aspx>.

Case study on Amazon EC2

Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides resizable compute capacity in the cloud. It is designed to make web-scale computing easier for developers.

Amazon EC2's simple web service interface allows you to obtain and configure capacity with minimal friction. It provides you with complete control of your computing resources and lets you run on Amazon's proven computing environment. Amazon EC2 reduces the time required to obtain and boot new server instances to minutes, allowing you to quickly scale capacity, both up and down, as your computing requirements change. Amazon EC2 changes the economics of computing by allowing you to pay only for capacity that you actually use. Amazon EC2 provides developers the tools to build failure resilient applications and isolate themselves from common failure scenarios.

Features of EC2

Here is a list of some of the prominent features of EC2 –

- **Reliable** – Amazon EC2 offers a highly reliable environment where replacement of instances is rapidly possible. Service Level Agreement commitment is 99.9% availability for each Amazon EC2 region.
- **Designed for Amazon Web Services** – Amazon EC2 works fine with Amazon services like Amazon S3, Amazon RDS, Amazon DynamoDB, and Amazon SQS. It provides a complete solution for computing, query processing, and storage across a wide range of applications.
- **Secure** – Amazon EC2 works in Amazon Virtual Private Cloud to provide a secure and robust network to resources.
- **Flexible Tools** – Amazon EC2 provides the tools for developers and system administrators to build failure applications and isolate themselves from common failure situations.
- **Inexpensive** – Amazon EC2 wants us to pay only for the resources that we use. It includes multiple purchase plans such as On-Demand Instances, Reserved Instances, Spot Instances, etc. which we can choose as per our requirement.

EC2 Components

In AWS EC2, the users must be aware about the EC2 components, their operating systems support, security measures, pricing structures, etc.

Operating System Support

Amazon EC2 supports multiple OS in which we need to pay additional licensing fees like: Red Hat Enterprise, SUSE Enterprise and Oracle Enterprise Linux, UNIX, Windows Server, etc. These OS needs to be implemented in conjunction with Amazon Virtual Private Cloud (VPC).

Security

Users have complete control over the visibility of their AWS account. In AWS EC2, the security systems allow create groups and place running instances into it as per the requirement. You can specify the groups with which other groups may communicate, as well as the groups with which IP subnets on the Internet may talk.

Pricing

AWS offers a variety of pricing options, depending on the type of resources, types of applications and database. It allows the users to configure their resources and compute the charges accordingly.

Fault tolerance

Amazon EC2 allows the users to access its resources to design fault-tolerant applications. EC2 also comprises geographic regions and isolated locations known as availability zones for fault tolerance and stability. It doesn't share the exact locations of regional data centers for security reasons.

When the users launch an instance, they must select an AMI that's in the same region where the instance will run. Instances are distributed across multiple availability zones to provide continuous services in failures, and Elastic IP (EIPs) addresses are used to quickly map failed instance addresses to concurrent running instances in other zones to avoid delay in services.

Migration

This service allows the users to move existing applications into EC2. It costs \$80.00 per storage device and \$2.49 per hour for data loading. This service suits those users having large amount of data to move.

Benefits

ELASTIC WEB-SCALE COMPUTING

Amazon EC2 enables you to increase or decrease capacity within minutes, not hours or days. You can commission one, hundreds or even thousands of server instances simultaneously. Of course, because this is all controlled with web service APIs, your application can automatically scale itself up and down depending on its needs.

COMPLETELY CONTROLLED

You have complete control of your instances. You have root access to each one, and you can interact with them as you would any machine. You can stop your instance while retaining the data on your boot partition and then subsequently restart the same instance using web service APIs. Instances can be rebooted remotely using web service APIs. You also have access to console output of your instances.

FLEXIBLE CLOUD HOSTING SERVICES

You have the choice of multiple instance types, operating systems, and software packages. Amazon EC2 allows you to select a configuration of memory, CPU, instance storage, and the boot partition size that is optimal for your choice of operating system and application. For example, your choice of operating systems includes numerous Linux distributions, and Microsoft Windows Server.

DESIGNED FOR USE WITH OTHER AMAZON WEB SERVICES

Amazon EC2 works in conjunction with Amazon Simple Storage Service (Amazon S3), Amazon Relational Database Service (Amazon RDS) and Amazon Simple Queue Service (Amazon SQS) to provide a complete solution for computing, query processing and storage across a wide range of applications.

RELIABLE

Amazon EC2 offers a highly reliable environment where replacement instances can be rapidly and predictably commissioned. The service runs within Amazon's proven network infrastructure and datacenters.

SECURE

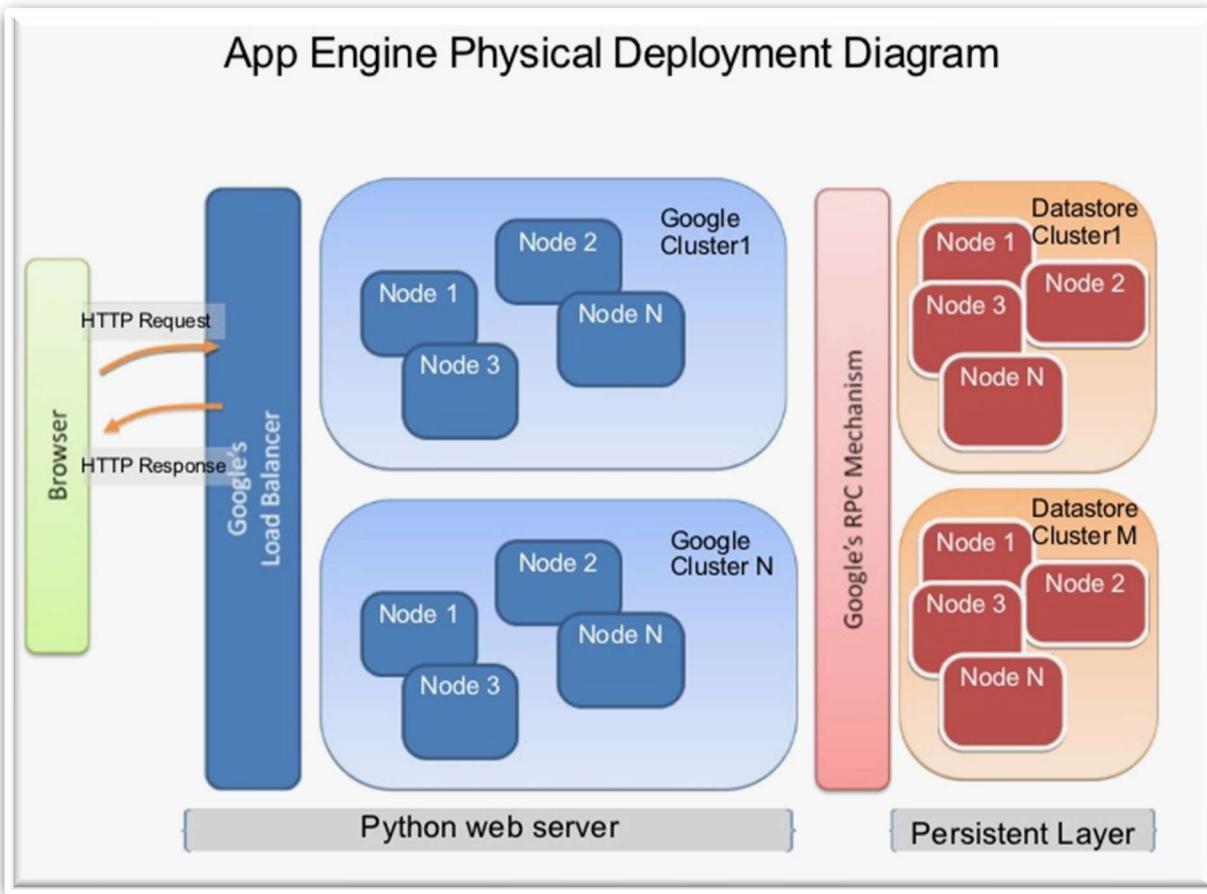
Amazon EC2 works in conjunction with Amazon VPC to provide security and robust networking functionality for your compute resources. Your compute instances are located in a Virtual Private Cloud (VPC) with an IP range that you specify. You decide which instances are exposed to the Internet and which remain private.

- Security Groups and networks ACLs allow you to control inbound and outbound network access to and from your instances.
- You can provision your EC2 resources as Dedicated Instances. Dedicated Instances are Amazon EC2 Instances that run on hardware dedicated to a single customer for additional isolation.
- If you do not have a default VPC you must create a VPC and launch instances into that VPC to leverage advanced networking features such as private subnets, outbound security group filtering, network ACLs and Dedicated Instances.

INEXPENSIVE

Amazon EC2 passes on to you the financial benefits of Amazon's scale. You pay a very low rate for the compute capacity you actually consume.

Case Study Google App Engine



Google App Engine (often referred to as GAE or simply App Engine, and also used by the acronym GAE/J) is a platform as a service (PaaS) cloud computing platform for developing and hosting web applications in Google-managed data centres. Applications are sandboxed and run across multiple servers. App Engine offers automatic scaling for web applications—as the number of requests increases for an application, App Engine automatically allocates more resources for the web application to handle the additional demand. Google App Engine is free up to a certain level of consumed resources. Fees are charged for additional storage, bandwidth, or instance hours required by the application. It was first released as a preview version in April 2008, and came out of preview in September 2011.

Runtimes and frameworks

Currently, the supported programming languages are Python, Java (and, by extension, other JVM languages such as Groovy, JRuby, Scala, Clojure, Jython and PHP via a special version of Quercus), and Go. Google has said that it plans to support more languages in the future, and that the Google App Engine has been written to be language independent.

Reliability and Support

All billed High-Replication Datastore App Engine applications have a 99.95% uptime SLA

Portability Concerns

Developers worry that the applications will not be portable from App Engine and fear being locked into the technology. In response, there are a number of projects to create open-source back-ends for the various proprietary/closed APIs of app engine, especially the datastore. Although these projects are at various levels of maturity, none of them is at the point where installing and running an App Engine app is as simple as it is on Google's service. [AppScale](#) and TyphoonAE are two of the open source efforts.

AppScale can run Python, Java, and Go GAE applications on EC2 and other cloud vendors. TyphoonAE can run python App Engine applications on any cloud that support linux machines.

Web2py web framework offers migration between SQL Databases and Google App Engine, however it doesn't support several App Engine-specific features such as transactions and namespaces.

Differences with other application hosting

Compared to other scalable hosting services such as Amazon EC2, App Engine provides more infrastructure to make it easy to write scalable applications, but can only run a limited range of applications designed for that infrastructure. App Engine's infrastructure removes many of the system administration and development challenges of building applications to scale to hundreds of requests per second and beyond. Google handles deploying code to a cluster, monitoring, failover, and launching application instances as necessary. While other services let users install and configure nearly any *NIX compatible software, App Engine requires developers to use only its supported languages, APIs, and frameworks. Current APIs allow storing and retrieving data from a BigTable non-relational database; making HTTP requests; sending e-mail; manipulating images; and caching. Existing web applications that require a relational database will not run on App Engine without modification. Per-day and per-minute quotas restrict bandwidth and CPU use, number of requests served, number of concurrent requests, and calls to the various APIs, and individual requests are terminated if they take more than 60 seconds or return more than 32MB of data.

Differences between SQL and GQL

Google App Engine's datastore has a SQL-like syntax called "GQL". GQL intentionally does not support the Join statement, because it seems to be inefficient when queries span more than one machine. Instead, one-to-many and many-to-many relationships can be accomplished using ReferenceProperty(). This shared-nothing approach allows disks to fail without the system failing. Switching from a relational database to the Datastore requires a paradigm shift for developers when modelling their data.

Unlike a relational database the Datastore API is not relational in the SQL sense. The Java version supports asynchronous non-blocking queries using the Twig Object Datastore interface. This offers an alternative to using threads for parallel data processing.

Open-Source Cloud

An open-source cloud is designed and developed using open-source technologies and software such as:

- Open-source operating system, DBMS and software development frameworks
- Open-source workflow and business applications
- Virtualization stack (Hypervisor, virtualization management)
- Hardware with open-source firmware
-

Moreover, open-source cloud may also refer to any cloud service that provides open-source software or service to end users or businesses. Businesses/cloud providers have the option to customize open-source cloud solutions to a greater extent, which is generally prohibited in closed-source cloud models. Open-source cloud solutions generally are interoperable with any back-end platform and can easily be migrated to a different IT infrastructure/environment.

Open Nebula, Open Stack and Virtual Box are common examples of open-source cloud.

Eucalyptus vs OpenNebula

Eucalyptus vs OpenNebula: What are the differences?

Eucalyptus: *Open source AWS compatible private cloud* *. Eucalyptus is open source software for building private, AWS-compatible IT, QA, and developer clouds. It makes it easy to deliver cloud computing, just like AWS, from within your data center; ***OpenNebula:**** *Open Source Cloud manager*. It provides a simple but feature-rich and flexible solution for the comprehensive management of virtualized data centers to enable on-premise enterprise clouds in existing infrastructures. It can be primarily used as a virtualization tool to manage your virtual infrastructure in the data-center or cluster, which is usually referred as Private Cloud. OpenNebula supports Hybrid Cloud to combine local infrastructure with public cloud-based infrastructure, enabling highly scalable hosting environments. OpenNebula also supports Public Clouds by providing Cloud interfaces to expose its functionality for virtual machine, storage and network management.

Eucalyptus and OpenNebula can be primarily classified as "**Open Source Cloud**" tools.

Some of the features offered by Eucalyptus are:

- **Hybrid Cloud Management** - Launch instances, create snapshots and manage autoscaling groups in either your private or public clouds from a single environment. Now the same powerful and easy to use self-service interface that provisions and manages Eucalyptus Cloud resources can manage your AWS cloud resources.
- **AWS Compatibility** - Eucalyptus provides industry-leading compatibility with popular Amazon Web Services (AWS) APIs including EC2, S3, Elastic Block Store (EBS), Identity and Access Management (IAM), Auto Scaling, Elastic Load Balancing (ELB), and CloudWatch.
- **Compute** - Eucalyptus allows you to use industry-standard servers, storage, networking, and virtualization technologies to deliver cost-effective, AWS-compatible cloud services in your datacenter. Eucalyptus is compatible with AWS's EC2 and allows you to easily deploy compute resources and efficiently increase or decrease compute capacity based on application demands.

On the other hand, OpenNebula provides the following key features:

- flexible
- robust
- powerful

What is Eucalyptus?

Eucalyptus is open source software for building private, AWS-compatible IT, QA, and developer clouds. It makes it easy to deliver cloud computing, just like AWS, from within your data center.

What is OpenNebula?

It provides a simple but feature-rich and flexible solution for the comprehensive management of virtualized data centers to enable on-premise enterprise clouds in existing infrastructures. It can be primarily used as a virtualization tool to manage your virtual infrastructure in the data-center or cluster, which is usually referred as Private Cloud. It supports Hybrid Cloud to combine local infrastructure with public cloud-based infrastructure, enabling highly scalable hosting environments.

What companies use Eucalyptus?

- Electronic Arts
- Sony
- AppDynamics
- AppDynamics
- NASA Jet Propulsion Laboratory

What companies use OpenNebula?

- Trivago
- Immowelt Group
- Runtastic
- Deutsche Post IT Services (Berlin) GmbH
- SnappMarket
- DET-IO
- Africa-Arabia Regional Operations Centre

What tools integrate with Eucalyptus?

- Amazon S3
- Amazon EC2
- Amazon Route 53
- AWS Elastic Load Balancing (ELB)
- Amazon DynamoDB
- Amazon VPC
- Amazon ElastiCache

What tools integrate with OpenNebula?

- Java
- CloudFlare
- Ruby
- Dropbox
- Zoho
- BelugaCDN

What are some alternatives to Eucalyptus and OpenNebula?

Bamboo

Focus on coding and count on Bamboo as your CI and build server! Create multi-stage build plans, set up triggers to start builds upon commits, and assign agents to your critical builds and deployments.

OpenStack

OpenStack is a cloud operating system that controls large pools of compute, storage, and networking resources throughout a datacenter, all managed through a dashboard that gives administrators control while empowering their users to provision resources through a web interface.

Apache CloudStack

It is open source software designed to deploy and manage large networks of virtual machines, as a highly available, highly scalable Infrastructure as a Service (IaaS) cloud computing platform.

MaaS

MAAS (Metal as a Service) offers cloud style provisioning for physical servers. It is open source and free to use, with commercial support available from Canonical.

VirtKick

Software as a service platform for hosting providers.

Thanks ☺

