**UNIT-1**

**Overview of Cloud Computing:**

**Meaning of the terms cloud and cloud computing:**

**Cloud:**

* The term *cloud* is simply how a network or [remote servers](https://www.lifewire.com/fpbf-file-2621399) can be accessed via an [internet](https://www.lifewire.com/difference-between-the-internet-and-the-web-2483335) connection to store and manage information. In other words, it’s a place other than your computer that you can use to store your stuff.
* Cloud, in technical terminology, is a storage space system that allows the user to save their data on virtual servers.
* Virtual servers means a server that is located somewhere across the globe, according to the vendor you are using.
* Your data is saved on the virtual space and can be accessed from anywhere in the world remotely, with an internet connection.
* Cloud is storing data on a server and the data can be accessed anywhere on earth so long as you are connected to the internet.
* Facebook, twitter, Google Drive ,wordpress and even quota are examples of cloud. Anywhere in the world, so long as there is no censorship you can access their services.
* For example, consider Amazons S3 Storage Service. This is a data storage service designed for use across the Internet
* Amazon S3 provides a simple web services interface that can be used to store and retrieve any amount of data, at any time, from anywhere on the web

**Cloud computing:**

* Cloud computing is the the use of various services, such as software development platforms, servers, storage and software, over the internet
* Cloud Computing can be defined as delivering computing power( CPU, RAM, Network Speeds, Storage OS software) a service over a network (usually on the internet) rather than physically having the computing resources at the customer location.
* Data and programs stored or hosted on the cloud can be accessed/worked upon on a regular basis.
* This technology brings the world to one platform and gives us an opportunity to work faster and with more efficiency.
* The computing resources are managed centrally which are located over multiple servers in clusters. Users can access software and applications from wherever they need without worrying about storing their own data. It simply breaks down to “pay only for what you need”.
* Cloud computing has emerged as a popular solution to provide cheap and easy access to externalized IT (Information

Technology) resources. An increasing number of organizations (e.g., research centres, enterprises) benefit from Cloud computing to host their applications.

**Example:**AWS, Azure, Google Cloud

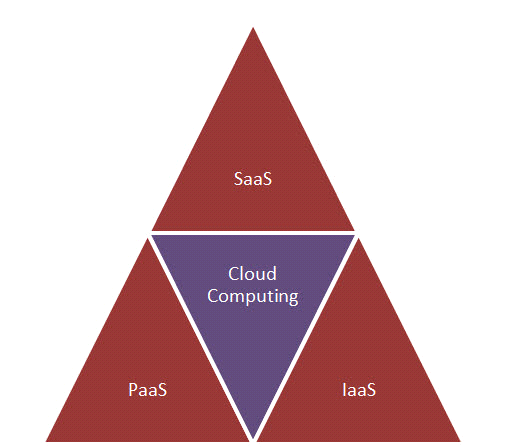
**Some distinguishing factors between cloud storage and cloud computing include:**

* Cloud computing requires higher processing power than cloud storage. Cloud storage, on the other hand, needs more storage space.
* Cloud computing is essentially targeted towards businesses. Cloud storage, on the other hand, is utilized both for professional and personal reasons.
* Cloud storage is simply a data storage and sharing medium, while cloud computing gives you the ability to remotely work on and transform data (for example, coding an application remotely).

**Cloud-Based Service Offerings**

Earlier we used to store our data in hard drives on a computer. Cloud Computing services have replaced such hard drive technology. Cloud Computing service is nothing but providing services like Storage, Databases, Servers, networking and the software through the Internet.Few Companies offer such computing services, hence named as **“**Cloud Computing Providers/ Companies**”.**They charge its users for utilizing such services and the charges are based on their usage of services.In our daily routine, we use this cloud service without our notice like web-based email service, watching movies through the internet, editing documents and storing picture uses cloud computing on the back-end.Using such cloud technology we can design and create new applications, store and recover data and hosting the website.

**Generally, cloud computing services are categorized into three types.**



**1)Infrastructure as a Service (IaaS):**

* This service provides the infrastructure like Servers, Operating Systems, Virtual server space, Networks connections,bandwidth,load balancers,and Storage on rent basis like pay-as-you-go.
* Annually a lot of money is spent in maintenance and buying new components like hard-drives, network connections, external storage device etc. which a business owner could have saved for other expenses by using IaaS.
* The users can access the software applications without the concerns of installation and maintenance because Service providers will install their software applications which operated by them for the users to use as a service.
* SaaS is popular due to its scalability, compatibility, accessible worldwide and the users do not need to do/worry about scaling, configuration and updates.
* The pool of hardware resource is extracted from multiple servers and networks usually distributed across numerous data centers.
* **Eg:**Amazon Web Service, Microsoft Azure

**2) Platform as a Service (PaaS):**

* Platform as a service refers to cloud computing services that supply an on-demand environment for developing, testing, delivering and managing software applications.
* PaaS is designed to make it easier for developers to quickly create web or mobile apps, without worrying about setting up or managing the underlying infrastructure of servers, storage, network and databases needed for development.
* PaaS services are constantly updated & new features added. Software developers, web developers and business can benefit from PaaS.
* **Eg:** Microsoft Azure,Google App ,Apprenda, Red Hat OpenShift

**3) Software as a Service (SaaS):**

* Software as a service is a method for delivering software applications over the Internet, on demand and typically on a subscription basis.
* With SaaS, cloud providers host and manage the software application and underlying infrastructure and handle any maintenance, like software upgrades and security patching.
* Traditionaly, software application needed to be purchased upfront &then installed it onto your computer. SaaS users on the other hand, instead of purchasing the software subscribes to it, usually on monthly basisvia internet.
* Users connect to the application over the Internet, usually with a web browser on their phone, tablet or PC.
* Important tasks like accounting, sales, invoicing and planning all can be performed using SaaS.
* **Eg:** Google Applications like Google Docs , Salesforce.com, Microsoft Office 365

**Grid Computing vs Cloud Computing**

Grid computing is a form of distributed computing that implements a virtual supercomputer made up of a cluster of networked or Internetworked computers acting in union to perform very large tasks. grid computing is a computer network in which each computer’s resources are shared. Processing power, memory, and data storage are all community resources. Therefore authorized users can tap into and leverage these resources for specific tasks.

|  |  |  |
| --- | --- | --- |
| **Parameter** | **Grid computing** | **Cloud computing** |
| Goal | Collaborative sharing of resources | Use of service (Assigned resources are not shared) |
| Degree of scalability | Normal | High |
| Time to run | Not real-time | Real-time services |
| Security | Low (grid certificate service) | High (Virtualization) |
| Operating System | Any standard OS | A hypervisor (VM) on which  multiple OSs run |
| Resource management | Distributed | Centralized/Distributed |
| Type of service | CPU, network, memory, bandwidth,  device, storage,… | IaaS, PaaS, SaaS,  Everything as a service |
| Ownership | Multiple | Single |
| Resource | Limited (because hardware are  limited) | Unlimited |
| Example of real world | SETI, BOINC, Folding@home,  GIMPS | Amazon Web Service (AWS),  Google apps |

**BENEFITS OF CLOUD COMPUTING**

There are numerous benefits in cloud computing. Major benefits are explained below.

**1. Cost Savings**: Cloud computing provide facility to use services such as infrastructure, platform etc based upon requirements, it helps to reduce the initial cost, avoid the setting of high capacity servers and others that are capable of more than needy one. It charges amount depending upon usage of infrastructure, platform and other services, this helps consumers to reduce the expense by specifying the exact requirements.

**2,.Time Saving:** Cloud computing reduce the set up time of organizations by providing all facility simultaneously. No need of waiting to set up the infrastructure, platform and others and avoid the initial headache. This helps organizations to save time, helps to run trial basis initially and gradually move to a permanent condition.

**3.Scalability and Flexibility:** As discussed in second benefit, companies can start with a small set up and grow to a large condition fairly rapidly, and then scale back if necessary. Also, the flexibility of cloud computing allows companies to use extra resources at peak times, enabling them to satisfy consumer demands. Moreover cloud computing is ready to meet any peak time requirement by setting up with high capacity servers, storages etc.

**4.Backup and Recovery:** Since all the data is stored in the cloud, backing it up and restoring the same is relatively much easier than storing the same on a physical device. Also it has many techniques to recover it from any type of disaster.

**5.Automatic software updates:** All the software’s need update and the great thing with cloud computing is that you do not have to worry for any updates and also your organization will not have any additional expenses when a new upgrade or update is necessary.

**6.Unlimited storage capacity:** The cloud offers virtually limitless storage capacity but at any time you can expand your storage capacity with a small additional charge on your monthly fee.

**7. Reliability :** Services using multiple redundant sites can support business continuity and disaster recovery.

**8. Mobile Access:** The cloud computing enables to access high- powered computing and storage resources for anyone with a network access device. Employees can access and work on their application by sitting home, no need of going to office or organization. Moreover nowadays number of mobile users is very high compare to the users of PCs and other devices. Consumers can access their files and other applications anytime from anywhere by using their mobiles. This has increased the rate of adopting cloud computing technology.

**9.Multisharing:** Cloud computing offers sharing of architecture and other applications for multiple users. With the cloud working in a distributed and shared mode, multiple users and applications can work more efficiently with cost reductions by sharing common infrastructure

**10. Customization**: Cloud computing is a platform where we can modify to our needs with being redevelopment. It offers a platform for creating and amending applications to address a diversity of tasks and challenges.

**11. Deliver new services:** Cloud services are provided by multi-national companies like Amazon, Google, IBM, Microsoft, Salesforce.com, etc. These companies can easily deliver any new application/product at the release time itself.

**12.Anywhere access to your documents**: When you are in the cloud, there is no need to take your documents with you. Instead, you can access your actual PC from anywhere that there is Internet access available.

**LIMITATIONS**

**1. Internet connection is required:**

It is impossible to work if your Internet connection is down. Since you are using Internet to connect to your “cloud PC”, if there is no Internet connection simply you cannot connect

**2.Stored data might not be secure:**

Data is stored “in the cloud”. However, where exactly is the cloud and is it really secure? These are questions arising for users that have confidential data.

**3.May not get all the features.**

Not all [cloud services](https://www.stratospherenetworks.com/blog/chicago-it-support-hybrid-clouds-versus-public-clouds/) are the same. Some cloud providers tend to offer limited versions and enable the most popular features only, so you may not receive every feature or customization you want. Before signing up, make sure you know what your cloud service provider offers.

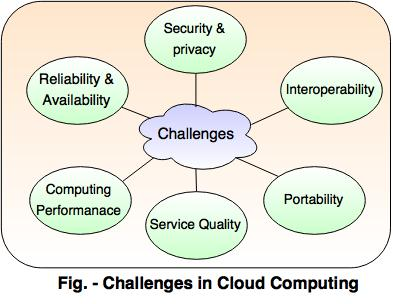
**4.no control on the resources:**

**5.Your data is 100% in the cloud**:

All the data that you had until now on your local PC, it is stored in the cloud. Theoretically, data stored in the cloud is safe since a cloud hosting company uses several ways of backup in order ensure that on any case the data will not be lost. However, if your data is missing (even one in a million), you have no physical or local backup of your data.

**6.Downtime –**Downtime is considered as one of the biggest potential downside of using Cloud computing. Your cloud providers may sometimes face technical outages which can happen due to various reasons such as loss of power, low internet connectivity, data centres going out of service for maintenance etc. This can lead to a temporary downtime in your cloud service

**Challenges in Cloud Computing**



**1.Security and Privacy**

The main challenge to cloud computing is how it addresses the security and privacy concerns of businesses thinking of adopting it. The fact that the valuable enterprise data will reside outside the corporate firewall raises serious concerns. Hacking and various attacks to cloud infrastructure would affect multiple clients even if only one site is attacked. These risks can be mitigated by using security applications, encrypted file systems, data loss software, and buying security hardware to track unusual behavior across servers.

It is difficult to assess the costs involved due to the on-demand nature of the services. Budgeting and assessment of the cost will be very difficult unless the provider has some good and comparable benchmarks to offer. The service-level agreements (SLAs) of the provider are not adequate to guarantee the availability and scalability. Businesses will be reluctant to switch to cloud without a strong service quality guarantee.

**2.Interoperability**

The application on one platform should be able to incorporate services from the other platform. This is known as Interoperability.

It is becoming possible through web services, but to develop such web services is complex.

**3.Portability**

The applications running on one cloud platform can be moved to new cloud platform and it should operate correctly without making any changes in design, coding.

The portability is not possible, because each of the cloud providers uses different standard languages for their platform.

**4.Service Quality**

The Service-Level Agreements (SLAs) of the providers are not enough to guarantee the availability and scalability. The businesses disinclined to switch to cloud without a strong service quality guarantee.

**5.Computing Performance and bandwidth cost**

High network bandwidth is needed for data intensive applications on cloud, this results in high cost.

In cloud computing, low bandwidth does not meet the desired computing performance.

Businesses can save money on hardware but they have to spend more for the bandwidth. This can be a low cost for smaller applications but can be significantly high for the data-intensive applications. Delivering intensive and complex data over the network requires sufficient bandwidth. Because of this, many businesses are waiting for a reduced cost before switching to the cloud.

**6.Reliability and Availability**

Most of the businesses are dependent on services provided by third-party, hence it is mandatory for the cloud systems to be reliable and robust.

**key characteristics of Cloud Computing**

**1.On demand self services**:

computer services such as email, applications, network or server service can be provided without requiring human interaction with each service provider.

Cloud service providers providing on demand self services include Amazon Web Services (AWS), Microsoft, Google, IBM and Salesforce.com.

2. **Broad network access**:

Cloud Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client

platforms such as mobile phones, laptops and PDAs.

3.**Resource pooling**:

The provider’s computing resources are pooled together to serve multiple consumers using multiple-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand.

The resources include among others storage, processing, memory, network bandwidth, virtual machines and email services.

The pooling together of the resource builds economies of scale (Gartner).

4.**Rapid elasticity**:

Cloud services can be rapidly and elastically provisioned, in some cases

automatically, to quickly scale out and rapidly released to quickly scale in.

To the consumer, the capabilities available for provisioning often appear to be unlimited and can be purchased in any quantity at any time.

5.**Measured service**:

Cloud computing resource usage can be measured, controlled, and reported providing transparency for both the provider and consumer of the utilised service.

Cloud computing services use a metering capability which enables to control and optimise

resource use.

This implies that just like air time, electricity or municipality water IT services are charged per usage metrics – **pay per use**.

The more you utilise the higher the bill.

Just as utility companies sell power to subscribers, and telephone companies sell

voice and data services, IT services such as network security management, data center

hosting or even departmental billing can now be easily delivered as a contractual service.

**6.Remotely Hosted**

Services are data are hosted on remote infrastructure

**7.Ubiquitous**

Services or data are available from any where through the internet

**8.Resiliency**

cloud providers generally mirrors solutions to multiple data centers to minize down time in the event of disaster

**Legal issues of cloud computing**

The legal issues that frequently arise in the cloud are wide-ranging. However, attempting a broad generalisation, mainly four types of issues arise therein:

1. Privacy of data and data security
2. Issues relating to contractual relation between the cloud service provider and the customer
3. Complex jurisdictional issues, or issues relating to the location of the data and the set of laws applicable
4. Commercial as well as business considerations

At the outset, it may very well be clarified that though cloud computing enables the customer access to computing, networking, storage resources just like traditional outsourcing services and Application Service Providers (ASPs), it has a legal nature quite different from these two owing to its distinctive features like ‘on-demand access’, and ‘unit-based pricing’ (pay-per-use).

1.Privacy and data security issues:

The main privacy/data security issue relating to the cloud is ‘data breach’. Data breach may be in the generic sense defined as the loss of unencrypted electronically stored personal information A data breach can cause loss to both the provider as well as the customer in numerous ways; with identity theft and chances of debit/credit card fraud to the customer, and financial harm, loss of customer, loss of reputation, potential lawsuits et cetera for the provider.

The American law requires data breach notification to be issued of affected persons in such case of a data breach.

Talking about the Indian scenario, most of the providers are seen to attempt at lessening their risk liability in case of a data breach scenario.

2.Contracting Issues:

Clearly, licensing agreements are fundamentally different from Service agreements. Cloud essentially, in all its permutations (IaaS, PaaS, SaaS), is a service, and therefore is governed by a Service agreement instead of a Licensing agreement.

However, the main issue regarding the Cloud Service agreements is ‘contract of adhesion’. Owing to the limited expansion of Cloud Services in India, most of the time the ‘Click-wrap agreement’ model is used, causing the contract to be one of the contract of adhesion. It leaves no or little scope for negotiation on the part of the user/customer.

With the expansion of the Cloud computing, gradually the negotiation power of the large corporation will cause the Cloud Contracts to be standard and negotiated ones. However, at an individual level, this is still a far destination.

Legal provisions clearly cannot force the cloud providers to have a negotiating session with each and every customer. However, legal provisions may be made to ensure that the liability and risk responsibility clauses follow a standard pattern which compensates the user for the lack of negotiation during the formation of the contract.

**Jurisdictional Issues:**

Jurisdiction is the authority of a court to judge acts committed in a certain territory. Jurisdiction in case of legal issues relating to the Cloud services becomes difficult and critical because of the features of Cloud like ‘Virtualization’, and ‘Multi-tenancy’.

While virtualization ensures the requirement of less hardware and consumption of less power thereby ensuring computing efficiency, it also on the other hand makes it difficult for the cloud user or the cloud provider to know what information is housed on various machines at any given time.

Multi-tenancy refers to the ability of a cloud provider to deliver services to many individuals or organisations from a single shared software. The risk with this is that it makes it highly possible that the data of one user may be accessed in an unauthorised manner by another user since the data of various users are only virtually separated and not physically. Also, it makes it difficult to back up and restore data.

The cloud enables a great deal of flexibility in data location, which ensures maximum efficiency in data usage and accessibility. However, it creates a number of legal issues as well. It makes it quite possible a scenario that the same data may be stored in multiple locations at a given time. Now, if the multiple locations are subject to different jurisdiction and different legal system, there arises a possibility that there may be conflicting legal provisions regarding data in the two aforementioned different locations. This gives rise to most of the jurisdictional issues in Cloud computing.

Also, laws relating to confidentiality and Government access to data are different across different nations. While the Indian laws manage to strike a balance between national security and individual privacy, most of the nations do not prefer a balance and have adopted a biased view on this. Problem of conflict of laws arises herein, in such cases.

**Commercial and Business Considerations:**

Other commercial and business considerations like the urge to minimize risk, maintain data integrity, accessibility and availability of data as well as Service level Agreements have also significantly shaped the present as well as future of Cloud Computing in India. It also creates a number of foreseeable as well as unforeseeable issues that needs to be addressed by dedicated legislations therefor.

It is an accepted truth that Law always lags behind technical innovations, and the complexities of the Cloud innovations and related Cloud Services like Software as a Service (SaaS), Platform as a Service (PaaS), and Infrastructure as a Service (IaaS) will force the law and legislations to catch up in order for an effective legal system that provides legal remedies to prevent and redress the resultant harms.

Raising awareness, ensuring universal access to information, and resource mobilizing are complimentary solutions that’ll never go wrong for the Indian scenario in order to add to the effectiveness of an effective legal system.

[**data location**](https://searchcloudsecurity.techtarget.com/tip/Cloud-computing-legal-issues-data-location)

Organizations need to know where the data they’re responsible for – both personal customer data and corporate information will be located at all times. In the cloud environment, location matters, especially from a legal standpoint.

Cloud computing legal issues result from where a cloud provider keeps data, including application of foreign data protection laws and surveillance. In this tip, learn about cloud computing legal issues stemming from data location, and how to avoid them.

[**contracts and cloud outages**](https://searchcloudsecurity.techtarget.com/tip/Cloud-computing-contracts-and-cloud-outages)

When a cloud service goes down, users lose access to their data and therefore  may be unable to provide services to their customers. When is a cloud user compensated for the loss of service, and to what extent?  Users need to examine how cloud computing contracts account for cloud outages.

This tip discusses how a cloud outage could negatively affect business and examines some cloud computing contracts and their provisions for cloud outage