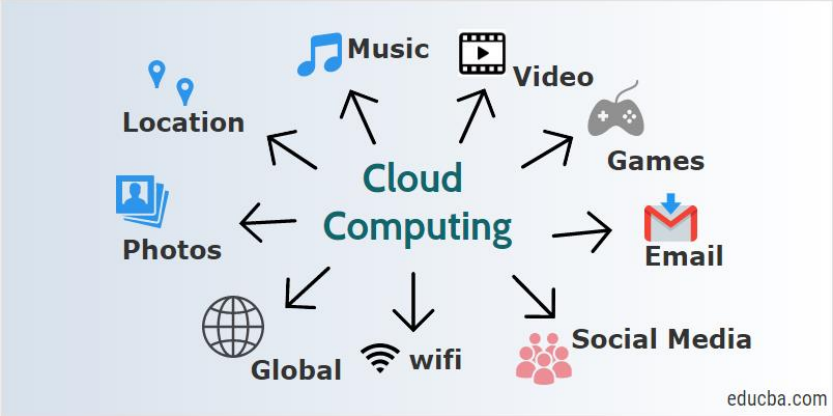
Unit-2 ICC

Cloud Computing Technology

Basics of cloud technology- cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale.



Cloud computing technology gives users access to storage, files, software, and servers through their internet-connected devices: computers, smartphones, tablets, and wearables. Cloud computing providers store and process data in a location that's separate from end users.

Essentially, cloud computing means having the ability to store and access data and programs over the internet instead of on a hard drive. This means businesses of any size can harness powerful software and IT infrastructure to become bigger, leaner, and more agile, as well as compete with much larger companies. Unlike with traditional hardware and software, cloud computing helps businesses stay at the forefront of technology without having to make large investments in purchasing, maintaining, and servicing equipment themselves.

There are 6 latest technologies in the cloud computing zone.

- Serverless.
- Containers.
- DevOps.
- Microservices.
- Artificial Intelligence.
- Internet of Things (IoT)

Artificial intelligence (AI) is now emerging as a game-changer in cloud computing. AI offers automatic pattern recognition, trend analysis, and predictive capabilities, empowering businesses to optimize operations and resource allocation while enhancing security through threat identification.

An IoT cloud is a massive network that supports IoT devices and applications. This includes the underlying infrastructure, servers and storage, needed for real-time operations and processing.

Instead of buying, owning, and maintaining physical data centers and servers, you can access technology services, such as computing power, storage, and databases, on an as-needed basis from a cloud provider like Amazon Web Services (AWS).

Beside the above Latest Technologies there are following Basic Cloud Computing Technologies as well.

1. Virtualization
2. Service-Oriented Architecture (SOA)
3. Grid Computing
4. Utility Computing

Virtualization

Virtualization is the process of creating a virtual environment to run multiple applications and operating systems on the same server. The virtual environment can be anything, such as a single instance or a combination of many operating systems, storage devices, network application servers, and other environments.

The concept of Virtualization in cloud computing increases the use of virtual machines. A virtual machine is a software computer or software program that not only works as a physical computer but can also function as a physical machine and perform tasks such as running applications or programs as per the user's demand.

Types of Virtualization

i. Hardware virtualization

ii. Server virtualization

iii. Storage virtualization

iv. Operating system virtualization

v. Data Virtualization

Service-Oriented Architecture (SOA)

Service-Oriented Architecture (SOA) allows organizations to access **on-demand** cloud-based computing solutions according to the change of business needs. It can work without or with cloud computing. The advantages of using SOA is that it is easy to maintain, platform independent, and highly scalable.

Service Provider and Service consumer are the two major roles within SOA.

Applications of Service-Oriented Architecture

There are the following applications of Service-Oriented Architecture -

- It is used in the healthcare industry.
- It is used to create many mobile applications and games.
- In the air force, SOA infrastructure is used to deploy situational awareness systems.

The service-oriented architecture is shown below:

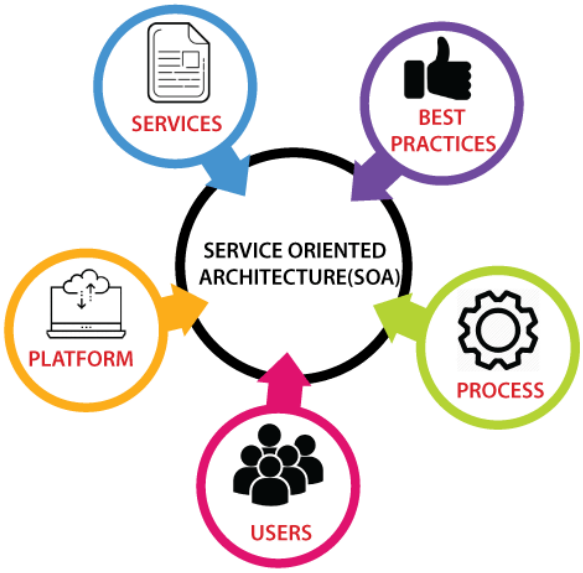


Fig. Service-Oriented Architecture (SOA)

Grid Computing

Grid computing is also known as **distributed computing**. It is a processor architecture that combines various different computing resources from multiple locations to achieve a common goal. In grid computing, the grid is connected by parallel nodes to

form a computer cluster. These computer clusters are in different sizes and can run on any operating system.

Grid computing contains the following three types of machines -

1. **Control Node:** It is a group of server which administrates the whole network.
2. **Provider:** It is a computer which contributes its resources in the network resource pool.
3. **User:** It is a computer which uses the resources on the network.

Mainly, grid computing is used in the **ATMs, back-end infrastructures,** and **marketing research**.

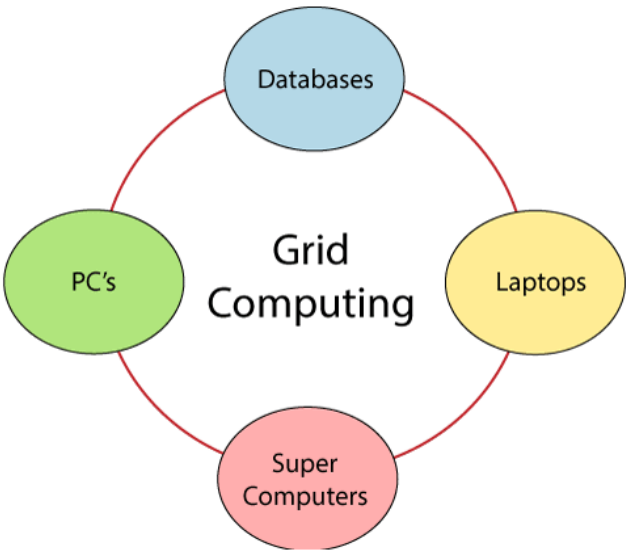


Fig. Grid Computing

Utility Computing

Utility computing is the most trending IT service model. It provides on-demand computing resources (computation, storage, and programming services via API) and infrastructure based on the **pay per use** method. It minimizes the associated costs and maximizes the efficient use of resources. The advantage of utility computing is that it reduced the IT cost, provides greater flexibility, and easier to manage.

Large organizations such as **Google** and **Amazon** established their own utility services for computing storage and application.

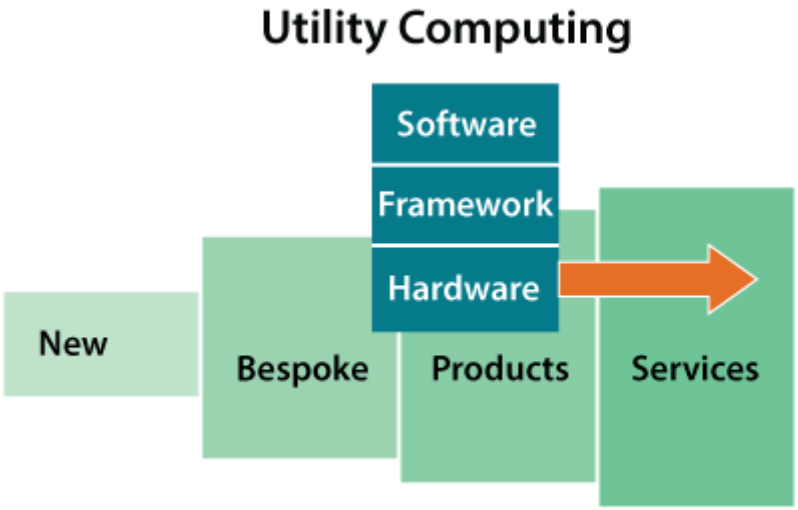


Fig. Utility Computing

Cloud Storage: - Cloud Storage is a mode of computer data storage in which digital data is stored on servers in off-site locations. The servers are maintained by a third-party provider who is responsible for hosting, managing, and securing data stored on its infrastructure.

In can also be defined in other words- The cloud storage is a computer data storage model in which the data that is digital in format is stored, and hence it is said to be on the cloud, in logical pools. This physical storage consists of multiple servers which can be located in the different parts of the country or may be in different parts of the world depends on many factors. The maintenance of these servers is owned by some private companies.

The cloud storage services are also responsible for keeping the data available and accessible 24x7, and it also safeguard the data and run the physical environment. In order to store user, entity, or application information, individuals and organisations purchase or lease storage capacity from providers.

The Cloud storage resources, for example a cloud desktop storage, a cloud storage portal or a Network-based content management system in the cloud. These all can be easily accessed with the help of a co-located cloud computing service or it can be a web service application programming interface which in general is known by the name of API or applications that use the API.

Architecture of Cloud Storage

In terms of interfaces the cloud storage is basically based on highly virtualized technology which is more like broader cloud computing. It is possible to use cloud storage services from an off-site provider (Amazon S3) or from an on-site provider (ViON Capacity Services).

Usually, cloud storage refers to a hosted object storage service, although the concept has extended to include other forms of data storage, such as block storage, that are also available as a service.

Some of the examples of cloud storage which can easily be hosted and deployed with cloud storage characteristics are as follows -, Oracle Cloud Storage, Microsoft Azure Storage and Amazon S3.

Cloud storage is-

- It consists of several distributed resources, but still functions as one, either in a cloud architecture of federated or cooperative storage.
- Highly fault-tolerant via redundancy and data distribution.
- Extremely durable through the manufacture of copies of versions.
- Ultimately, it is usually compatible with data replication advantages.
- Companies just need to pay for the storage they actually use, normally an average of a month's consumption. This does not indicate that cloud storage is less costly, rather that operating costs are incurred rather than capital expenses.
- Cloud storage companies can cut their energy usage by up to 70 percent, making them a greener company.
- The provision of storage and data security is inherent in the architecture of object storage, so the additional infrastructure, effort and expense to incorporate accessibility and security can be removed depending on the application.
- Tasks for storage management, such as the procurement of additional storage space, are offloaded to the service provider 's obligation.
- It provides users with immediate access of wide variety of tools and software housed in another organisation's infrastructure through a web service interface.
- As there are usually 2 or 3 separate backup servers located in different locations across the globe, cloud storage may be used as a natural disaster proof backup.

- With the WebDAV protocol, cloud storage can be mapped as a local drive. For organisations with several office locations, it may act as a central file server.

Data security

Data storage outsourcing increases the surface area of attack.

1. It is processed at more locations after information has been dispersed, raising the likelihood of unauthorised physical access to the data. For example , in the case of the disposal of old computers, the reuse of drives, the reallocation of storage space. The way data is replicated depends on the quality of service a customer prefers and the service delivered. It will maintain confidentiality when encryption is in effect. When disposing of data (on a disc), crypto-shredding can be used.
2. The number of persons who may be compromised (e.g., bribed, or coerced) with access to the data increases significantly. As for the sharing of multiple cloud data with multiple users, a large number of keys must be distributed to users for decryption through secure channels, and users must also store and manage it securely on their devices. It takes very costly safe storage to store these keys.
3. It increases the number of networks the data travels over.
4. It is possible for other customers to access the data by sharing storage and networks with many other users or customers. Sometimes due to wrongdoing, defective equipment, a malfunction, and sometimes due to criminal purpose. With encryption technology, the possibility of making data read during transmission can be mitigated. It is the role of the **transit encryption** in order to safeguard the data as it is transferred to and from the cloud service. In-rest encryption protects the data stored by the service provider. Both forms of encryption security can be offered by encrypting data in an on-site cloud service on-ramp scheme.

Longevity

Companies are not permanent and they may modify the services and goods they offer. Data storage outsourcing to another business requires careful investigation and nothing is ever assured. When a business ceases to exist or its circumstances change, contracts set in stone can be worthless. Companies are willing to:

1. Just go bankrupt.

2. Expand their concentration and modify it.
3. Be absorbed by other bigger firms.
4. To be bought by a company based in or moved to a country that refuses compliance with export restrictions and thus needs a transfer.
5. Suffering from an unrecoverable tragedy.

Accessibility

- Depending on how much a client is willing to invest on WAN bandwidth, outsourced storage efficiency is likely to be lower than local storage.
- Reliability and accessibility depend on the availability of the wide-area network and the extent of precautions taken by the service provider. Hardware as well as different algorithms used should be focused on reliability.
- A multiplicity of data storage is a given.
- Users with unique record-keeping requirements, such as public entities that must maintain electronic records in compliance with the law, can face cloud computing and storage complications.

Suggested Solution to Cloud Problems

To prevent such problems, there are many choices available. One choice is to use a private cloud (there are also services that provide private cloud storage) instead of a public cloud. Another choice is to ingest data inside our on-site infrastructure in an encrypted format where the key is kept.

Access is also achieved using on-premise cloud storage gateways. These gateways not only have options for encrypting and compressing data prior to transfer, but also for mirroring storage through various cloud storage providers and removing the possibility of shutdown by a single provider. Gateways also provide the option of caching data on a recently used on-premise algorithm. Data is cached and fetched in the most useful form along with data analytics instead of just recently used form.

Why is cloud storage important?

Cloud storage delivers cost-effective, scalable storage. You no longer need to worry about running out of capacity, maintaining storage area networks (SANs), replacing failed devices, adding infrastructure to scale up with demand, or operating underutilized hardware when demand decreases. Cloud storage is elastic, meaning you scale up and down with demand and pay only for what you use. It is a way for

organizations to save data securely online so that it can be accessed anytime from any location by those with permission.

Whether you are a small business or a large enterprise, cloud storage can deliver the agility, cost savings, security, and simplicity to focus on your core business growth. For small businesses, you no longer have to worry about devoting valuable resources to manage storage yourself, and cloud storage gives you the ability to scale as the business grows.

For large enterprises with billions of files and petabytes of data, you can rely on the scalability, durability, and cost savings of cloud storage to create centralized data lakes to make your data accessible to all who need it.

Cost effectiveness

With cloud storage, there is no hardware to purchase, no storage to provision, and no extra capital being used for business spikes. You can add or remove storage capacity on demand, quickly change performance and retention characteristics, and only pay for storage that you actually use. As data becomes infrequently and rarely accessed, you can even automatically move it to lower-cost storage, thus creating even more cost savings. By moving storage workloads from on premises to the cloud, you can reduce total cost of ownership by removing overprovisioning and the cost of maintaining storage infrastructure.

Increased agility

With cloud storage, resources are only a click away. You reduce the time to make those resources available to your organization from weeks to just minutes. This results in a dramatic increase in agility for your organization. Your staff is largely freed from the tasks of procurement, installation, administration, and maintenance. And because cloud storage integrates with a wide range of analytics tools, your staff can now extract more insights from your data to fuel innovation.

Faster deployment

When development teams are ready to begin, infrastructure should never slow them down. Cloud storage services allow IT to quickly deliver the exact amount of storage needed, whenever and wherever it's needed. Your developers can focus on solving complex application problems instead of having to manage storage systems.

Efficient data management

By using cloud storage lifecycle management policies, you can perform powerful information management tasks including automated tiering or locking down data in support of compliance requirements. You can also use cloud storage to create multi-

region or global storage for your distributed teams by using tools such as replication. You can organize and manage your data in ways that support specific use cases, create cost efficiencies, enforce security, and meet compliance requirements.

Virtually unlimited scalability

Cloud storage delivers virtually unlimited storage capacity, allowing you to scale up as much and as quickly as you need. This removes the constraints of on-premises storage capacity. You can efficiently scale cloud storage up and down as required for analytics, data lakes, backups, or cloud native applications. Users can access storage from anywhere, at any time, without worrying about complex storage allocation processes, or waiting for new hardware.

Business continuity

Cloud storage providers store your data in highly secure data centers, protecting your data and ensuring business continuity. Cloud storage services are designed to handle concurrent device failure by quickly detecting and repairing any lost redundancy. You can further protect your data by using versioning and replication tools to more easily recover from both unintended user actions or application failures.

With cloud storage services, you can:

- Cost-effectively protect data in the cloud without sacrificing performance.
- Scale up your backup resources in minutes as data requirements change.
- Protect backups with a data center and network architecture built for security-sensitive organizations.

How does cloud storage work?

Cloud storage is delivered by a cloud services provider that owns and operates data storage capacity by maintaining large datacenters in multiple locations around the world. Cloud storage providers manage capacity, security, and durability to make data accessible to your applications over the internet in a pay-as-you-go model. Typically, you connect to the storage cloud either through the internet or through a dedicated private connection, using a web portal, website, or a mobile app. When customers purchase cloud storage from a service provider, they turn over most aspects of the data storage to the vendor, including capacity, security, data availability, storage servers and computing resources, and network data delivery. Your applications access cloud storage through traditional storage protocols or directly using an application programming interface (API). The cloud storage provider might also offer services designed to help collect, manage, secure, and analyze data at a massive scale.

What are the types of cloud storage?

There are three main cloud storage types: object storage, file storage, and block storage. Each offers its own advantages and has its own use cases.

Object storage

Organizations have to store a massive and growing amount of unstructured data, such as photos, videos, machine learning (ML), sensor data, audio files, and other types of web content, and finding scalable, efficient, and affordable ways to store them can be a challenge. Object storage is a data storage architecture for large stores of unstructured data. Objects store data in the format it arrives in and makes it possible to customize metadata in ways that make the data easier to access and analyze. Instead of being organized in files or folder hierarchies, objects are kept in secure buckets that deliver virtually unlimited scalability. It is also less costly to store large data volumes.

Applications developed in the cloud often take advantage of the vast scalability and metadata characteristics of object storage. Object storage solutions are ideal for building modern applications from scratch that require scale and flexibility, and can also be used to import existing data stores for analytics, backup, or archive.

File storage

File-based storage or file storage is widely used among applications and stores data in a hierarchical folder and file format. This type of storage is often known as a network-attached storage (NAS) server with common file level protocols of Server Message Block (SMB) used in Windows instances and Network File System (NFS) found in Linux.

Block storage

Enterprise applications like databases or enterprise resource planning (ERP) systems often require dedicated, low-latency storage for each host. This is analogous to direct-attached storage (DAS) or a storage area network (SAN). In this case, you can use a cloud storage service that stores data in the form of blocks. Each block has its own unique identifier for quick storage and retrieval.

What cloud storage requirements should you consider?

Ensuring your company's critical data is safe, secure, and available when needed is essential. There are several fundamental requirements when considering storing data in the cloud.

Durability and availability

Cloud storage simplifies and enhances traditional data center practices around data durability and availability. With cloud storage, data is redundantly stored on multiple devices across one or more data centers.

Security

With cloud storage, you control where your data is stored, who can access it, and what resources your organization is consuming at any given moment. Ideally, all data is encrypted, both at rest and in transit. Permissions and access controls should work just as well in the cloud as they do for on-premises storage.

What are cloud storage use cases?

Cloud storage has several use cases in application management, data management, and business continuity. Let's consider some examples below.

Analytics and data lakes

Traditional on-premises storage solutions can be inconsistent in their cost, performance, and scalability — especially over time. Analytics demand large-scale, affordable, highly available, and secure storage pools that are commonly referred to as data lakes.

Data lakes built on object storage keep information in its native form and include rich metadata that allows selective extraction and use for analysis. Cloud-based data lakes can sit at the center of multiple kinds of data warehousing and processing, as well as big data and analytical engines, to help you accomplish your next project in less time and with more targeted relevance.

Backup and disaster recovery

Backup and disaster recovery are critical for data protection and accessibility, but keeping up with increasing capacity requirements can be a constant challenge. Cloud storage brings low cost, high durability, and extreme scale to data backup and recovery solutions. Embedded data management policies can automatically migrate data to lower-cost storage based on frequency or timing settings, and archival vaults can be created to help comply with legal or regulatory requirements. These benefits allow for tremendous scale possibilities within industries such as financial services, healthcare and life sciences, and media and entertainment that produce high volumes of unstructured data with long-term retention needs.

Software test and development

Software test and development environments often require separate, independent, and duplicate storage environments to be built out, managed, and decommissioned. In addition to the time required, the up-front capital costs required can be extensive.

Many of the largest and most valuable companies in the world create applications in record time by using the flexibility, performance, and low cost of cloud storage. Even the simplest static websites can be improved at low cost. IT professionals and developers are turning to pay-as-you-go storage options that remove management and scale headaches.

Cloud data migration

The availability, durability, and low cloud storage costs can be very compelling. On the other hand, IT personnel working with storage, backup, networking, security, and compliance administrators might have concerns about the realities of transferring large amounts of data to the cloud. For some, getting data into the cloud can be a challenge. Hybrid, edge, and data movement services meet you where you are in the physical world to help ease your data transfer to the cloud.

Compliance

Storing sensitive data in the cloud can raise concerns about regulation and compliance, especially if this data is currently stored in compliant storage systems. Cloud data compliance controls are designed to ensure that you can deploy and enforce comprehensive compliance controls on your data, helping you satisfy compliance requirements for virtually every regulatory agency around the globe. Often through a shared responsibility model, cloud vendors allow customers to manage risk effectively and efficiently in the IT environment, and provide assurance of effective risk management through compliance with established, widely recognized frameworks and programs.

Cloud-native application storage

Cloud-native applications use technologies like containerization and serverless to meet customer expectations in a fast-paced and flexible manner. These applications are typically made of small, loosely coupled, independent components called microservices that communicate internally by sharing data or state. Cloud storage services provide data management for such applications and provide solutions to ongoing data storage challenges in the cloud environment.

Archive

Enterprises today face significant challenges with exponential data growth. Machine learning (ML) and analytics give data more uses than ever before. Regulatory compliance requires long retention periods. Customers need to replace on-premises

tape and disk archive infrastructure with solutions that provide enhanced data durability, immediate retrieval times, better security and compliance, and greater data accessibility for advanced analytics and business intelligence.

Hybrid cloud storage

Many organizations want to take advantage of the benefits of cloud storage, but have applications running on premises that require low-latency access to their data, or need rapid data transfer to the cloud. Hybrid cloud storage architectures connect your on-premises applications and systems to cloud storage to help you reduce costs, minimize management burden, and innovate with your data.

Database storage

Because block storage has high performance and is readily updatable, many organizations use it for transactional databases. With its limited metadata, block storage is able to deliver the ultra-low latency required for high-performance workloads and latency sensitive applications like databases.

Block storage allows developers to set up a robust, scalable, and highly efficient transactional database. As each block is a self-contained unit, the database performs optimally, even when the stored data grows.

ML and IoT

With cloud storage, you can process, store, and analyze data close to your applications and then copy data to the cloud for further analysis. With cloud storage, you can store data efficiently and cost-effectively while supporting ML, artificial intelligence (AI), and advanced analytics to gain insights and innovate for your business.

Why is it called cloud storage?

- The name comes from the fact that the data gets stored on servers - in the cloud. So, it's safe to assume that the cloud is a slang term used by tech industry people to describe the servers and networking infrastructures that allow users to store and access data through the internet.

Where is cloud storage?

- They are not floating around in cyberspace. Cloud space exists on individual servers found at data centres and server farms around the world. Data centre and collocation providers offer server space for cloud computing.

The benefits of cloud storage-

- Accessibility and redundancy. ...

- Data security. ...
- Ability to collaborate on documents and files. ...
- Scalability. ...
- Cost and resource savings. ...
- Compliance with legislation and regulations for storing data. ...
- Archives and backup data.