

# In-Depth Analysis of Cloud Storage

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• **ABSTRACT** Data storage is a very relevant and adaptable service paradigm in which data is saved, accessed, and substantiated by a wide group of servers connected over the network. It benefits both individual users and businesses. Multiple cloud storage companies have emerged recently, offering a range of features and capabilities. The existing cloud offerings do not always meet users' needs and the variety makes it difficult to pick a storage platform.

• **KEYWORDS** paradigm; sophisticated; virtualization; cryptographic; SMB; cloud computing

## I. INTRODUCTION

The cloud or virtual storage is where you store your data. Cloud storage ensures that your data is safe. With the help of the cloud, we can access data in any region as long as we have an internet connection. There are three types of cloud: Hybrid, Private, Public and Community Cloud. Cloud storage helps us to store all of the data that we need to store. They just need a nominal subscription or lifetime fee. The cloud storage platforms are fully customisable. We can customize storage security according to our needs. Our Android or iPhone gives us access to all our data and we can also use the provider's app to access it [1]- [7].

Ubiquitous computing refers to the concept of embedding computing devices into everyday objects, making them part of the environment, while cloud computing refers to the use of remote servers to store, manage, and process data. Cloud computing supports ubiquitous computing by providing the necessary infrastructure for ubiquitous computing devices to access data, software, and services from remote servers over the internet [8].

Vehicular Ad hoc Networks (VANETs) rely on cloud computing to provide a platform for vehicles to access data, services, and applications. VANET's cloud environment enables this by allowing vehicles to communicate with remote servers over the internet, providing seamless connectivity and efficient resource utilization for vehicular communication [9].

Automated machine learning (AutoML) leverages the power of cloud computing to automate the process of building and deploying machine learning models. Cloud computing provides the necessary infrastructure and resources to perform complex computations, store large amounts of data, and scale resources as needed. AutoML platforms use cloud-based tools and services to automate data preparation, model selection, and hyperparameter tuning. This makes it easier for data scientists and developers to build accurate and scalable machine learning models without the need for extensive

knowledge of machine learning algorithms or infrastructure management. Cloud computing provides a seamless and efficient environment for AutoML to run, enabling organizations to accelerate their time-to-market and improve their business outcomes [10].

SDN enables edge computing devices to communicate with cloud resources efficiently. The combination of SDN and cloud computing supports low-latency applications such as IoT, autonomous vehicles, and industrial automation. Cloud computing infrastructure enables devices to access cloud resources quickly, reducing device workload and improving efficiency. SDN-aided edge computing creates a powerful ecosystem that supports a wide range of use cases [11]. Cloud cryptography leverages the power of cloud computing to provide secure and efficient encryption and decryption services. Cloud computing infrastructure provides the necessary resources to perform complex cryptographic operations, including key generation, storage, and management. Cloud cryptography is particularly useful for large-scale applications that require secure and efficient data transmission and storage, such as banking and finance, healthcare, and government. Cloud computing enables organizations to deploy advanced cryptographic algorithms and protocols without the need for extensive infrastructure and management resources [12].

By using cloud storage, machine learning models [13]- [15] can access and process data from anywhere in the world, making it easier to develop and deploy machine learning solutions [10] [16]- [20] on a global scale. Additionally, cloud storage can be integrated with other cloud-based services, such as data processing, data visualization, and data analytics, which can enhance the capabilities of machine learning solutions.

Speculative parallelization [21]- [25] is a method that allows processors to execute instructions without having to wait for the completion of previous instructions. This technique can enhance the efficiency and effectiveness of

parallel computing systems, particularly in data-intensive applications. It has the potential to improve the scalability and efficiency of cloud storage, making them more suitable for managing significant amounts of data. This is relevant to the data quality and metadata repository of cloud storage.

## II. ANALYZING DIFFERENT CLOUD STORAGE

### A. ANALYZING ON THE BASIS OF SPACE CAPACITY PROVIDED BY THE PROVIDERS [26]

For Individuals [27]

Provider Name	Maximum Storage	Free Storage
sync.com	6 TB	5 GB
pcloud	10 TB	10 GB
icedrive	10 TB	10 GB
Mega	16 TB	20 GB
Google Drive	2 TB	15 GB
OneDrive	6 TB	5 GB
DropBox	Unlimited	2 GB
iCloud	2 TB	5 GB
Mediafire	1 TB	10 GB

For Business or Team:

Provider Name	Maximum Storage	Free Storage
sync.com	Unlimited	5 GB
pcloud	Unlimited	10 GB
icedrive	10 TB	10 GB
Mega	16 TB	20 GB
Google Drive	2 TB	15 GB
OneDrive	Unlimited	5 GB
DropBox	Unlimited	2 GB
iCloud	2 TB	5 GB
Mediafire	2 TB	10 TB

### B. ANALYZING ON THE BASIS OF FEATURES PROVIDED BY THE PROVIDERS [26]

Provider Name	Sync Folder	File Link Sharing	Folder Sharing
sync.com	Yes	Yes	Yes
pcloud	Yes	Yes	Yes
icedrive	No	Yes	Yes
Mega	Yes	Yes	Yes
Google Drive	Yes	Yes	Yes
OneDrive	Yes	Yes	Yes
DropBox	Yes	Yes	Yes
iCloud	Yes	Yes	Yes
Mediafire	No	Yes	Yes

### C. ANALYZING ON THE BASIS OF CUSTOMER SUPPORT AND DEVICE/PLATFORM SUPPORT PROVIDED BY THE PROVIDERS [26]

Provider Name	24x7 Support	Phone Support	Device Support
sync.com	Yes	Yes	Android, IOS
pcloud	Yes	Yes	Android, IOS
icedrive	No	Yes	Android, IOS
Mega	Yes	No	Android, IOS
Google Drive	Yes	Yes	Android, IOS
OneDrive	Yes	Yes	Android, IOS
DropBox	Yes	Yes	Android, IOS
iCloud	Yes	Yes	IOS
Mediafire	Yes	Yes	Android, IOS

### D. ANALYZING ON THE BASIS OF SECURITY PROVIDED BY THE PROVIDERS [10]

Provider Name	Encrypted Storage	Encrypted Transfer	2FA
sync.com	Yes	Yes	Yes
pcloud	Yes	Yes	Yes
icedrive	Yes	Yes	Yes
Mega	Yes	Yes	Yes
Google Drive	Yes	Yes	Yes
OneDrive	Yes	Yes	Yes
DropBox	Yes	Yes	Yes
iCloud	Yes	Yes	Yes
Mediafire	No	No	No

## III. TYPES OF CLOUD

There are four types of Cloud:

### A. HYBRID CLOUD

Hybrid clouds are a mix of public and private clouds like public cloud and on-premises cloud servers. Includes storage, network, applications and compute. The benefits of using Hybrid Cloud are:

- I. Flexible,
- II. Low Latency,
- III. Can access anything even if you're not connected to on-premises servers,
- IV. Cost reduction,
- V. Can be easily expanded and more.

Hybrid cloud providers Microsoft Azure, Amazon AWS, Google etc [29]- [31].

### B. PRIVATE CLOUD

Private clouds are used within an organization or by a single user. They provide the highest security and privacy by using firewalls VPN. The third party providers cannot access the data since they don't have access to connect to the server. The benefits of Private cloud are: [32]

- I. Security privacy,
- II. Enhanced control and performance. A few problems with private clouds include:
  - I. Not cost-effective,
  - II. Need experienced personnel for control and maintenance,
  - III. Limited scalability.

Example: HP Data Center, IBM, RedHat etc [31] [33]- [34]

### IV. PUBLIC CLOUD

Public Cloud provides storage, compute, applications. Depending on your needs, public clouds can be paid or free. The internet allows us to access public cloud services. If the internet is not available, we can't access the public cloud. The benefits are: [35]

- I. Cost is very low as compared to other options,
- II. Independent of location,
- III. Time Saving,

- IV. Setup is easy,
- V. Scalable.

A few problems with public clouds include:

- I. Customization is limited,
- II. Security is lacking,
- III. The internet connection should be strong for its maximum performance.

There are many cloud providers such as Google Cloud, Microsoft Azure, Amazon AWS, Digital Ocean and more [31] [36].

#### A. PRIVATE CLOUD

Community clouds are the groups of organisations that are combined into a single cloud infrastructure to share information. These systems are managed and operated by different organizations. The benefits of using community cloud include:

- I. Enhanced security than public clouds,
- II. More flexible,
- III. Shared infrastructure.

A few problems with community clouds include:

- I. Not cost-effective than public clouds,
- II. Need experienced administrators,
- III. Bandwidth is fixed for all users, sharing makes it difficult to manage it.

For example: Government servers, hospital servers and more. [37]

#### V. WORKING OF CLOUD STORAGE

Cloud service companies have massive data centres all over the globe. Whenever a customer acquires cloud storage from one vendor, they entrust the vendor with most of the data storage aspects. These aspects include confidentiality, space, file servers and computing infrastructure, accessibility, and network distribution. Virtual information may be accessed by client applications using standard storage mechanisms or APIs, or it can be transferred to the cloud. Block storage, file storage, and object storage are the three basic types:

##### A. BLOCK STORAGE

In block storage, massive amounts of information are separated into smaller pieces known as blocks. Every chunk is assigned a distinct identity and is saved onto one of the device's discs. Block storage is fast and cost-effective, and it delivers the high throughput demanded by services such as analytics and excessive workloads [38].

##### B. FILE STORAGE

File storage is a cluster of documents and folders that is often utilised with personal hard disks and network-attached storage (NAS). Inside a digital storage solution, information is saved as files, and files are organised into folders. Classes and subclasses are used to organise

directories and discover information and files. A server with disk space can facilitate information accessibility and

recovery easier since users are accustomed with this hierarchical structure, which is required by some applications.

##### C. OBJECT STORAGE

It is kept in a datastore as entities, which consist of three constituents: information recorded on a disk, documentation associated with information records, and a unique key. Using the RESTful API, an object storage mechanism stores a file and its relevant metadata as a specific object and assigns it an authentication (ID) code. Once the identity is entered into the platform, the platform integrates the resource with all of its credentials, authentication, and assurance. In object-based storage solutions, documentation may be changed, which speeds up information retrieval and interpretation. With storage solutions, information can be preserved in its native format with incredible flexibility. [39]

Due to the delayed acceptance of object storage, object storage vendors have integrated root filesystem functions and features into their object storage software and hardware in recent history. For instance, an online storage portal can offer root filesystem virtualization to its object storage. This allows us to use data regardless of whether they support storage standards. Because all recovery programmes use the object storage standard, the first practical use was instantaneous restore to a remote server.

Cloud computing services for businesses typically make use of HDD installed on workstations and interconnected in a honeycomb pattern. It is most effective when the web server or products that use it are also in the cloud. High-performance layers, generally comprised of solid-state drives, have also been introduced to service providers' virtual storage services. High-performance cloud storage is often most successful when the servers and apps that utilise the storage are themselves cloud-based [40].

#### VI. THE BENEFITS AND DRAWBACKS OF CLOUD STORAGE

When compared to traditional storage area networks, cloud storage offers several advantages that result in cost savings and increased user comfort (SAN). There are other flaws with cloud storage, particularly in public services, that make businesses unwilling to adopt them or limit how they use them.

##### A. MERITS

- 1) Pay As You Go: Clients who adopt a cloud network only pay for the disk space they use, which eliminates the necessity for large financial expenditures. Although the expenses of online storage are continuous instead of discrete, they are routinely so cheap that even as a continuous expenditure, they could be cheaper than the cost of running an on-premises system.
- 2) Invoicing for Utilities: The cost of cloud computing may decrease as use declines even though users are only charged for the capacity they actually use. On the contrary, an in-house data centre would almost

certainly be overbuilt to meet planned growth. A firm would spend more on capacity than it needs at first, and storage costs will never go down.

- 3) **Global Accessibility:** Online storage is frequently available through any device, anywhere at the moment, and from any location; customers need not worry about lacking operating system capabilities or sophisticated distribution mechanisms.
- 4) **Simple to Use:** Since online storage is simple to access and use, programmers, application reviewers, and corporate customers might want to get started as soon as possible. There is no need to wait for an IT technician to assign and set up data storage.
- 5) **Off-site Protection:** By default, cloud-based preservation allows you to transfer replicas of your data to a distant location for recovery and prevention. As contrasted with a firm maintaining its own remote site, this delivers significant cost savings [41].

## B. DEMERITS

- 1) **Security:** Data integrity is probably the most commonly cited problem that prevents firms from adopting cloud computing infrastructures. The problem is that when information leaves a company's facilities, the company loses authority over how the information is treated and stored. Managed storage capacity is additionally a concern. Providers have sought to allay these fears by strengthening their security mechanisms through cryptographic protocols, biometrics (MFA), information storage in multiple places, and enhanced physical surveillance [42].
- 2) **Accessibility:** Sustaining the availability of cloud servers may also be a challenge, possibly significantly escalating the cost of using storage space. To accommodate the quantity of information that a company intends to send, its link to the cloud storage vendor might have to be improved. Link, for instance, might cost thousands of dollars each month.
- 3) **Performance Deterioration:** When a firm's in-house programs have to retrieve files from the cloud, efficiency issues may arise. Other cases will require transferring the data centres and applications to an existing infrastructure or transferring the appropriate data internally [41].
- 4) **Cost:** Expenses may be significant if a company requires a substantial quantity of virtual disk space and frequently moves information both on its systems and in the cloud. As compared to developing and maintaining an on-premises system, the ongoing expenses may ultimately outweigh the cost of creating and operating the on-premises framework [43].

## VII. CONSIDERATIONS FOR CLOUD STORAGE

To assess if online storage would lead to enhanced functional performance and cost, a corporation must follow the four steps outlined below:

- 1) Consider the following when comparing the one-time and recurrent expenses of acquiring and handling disk space against the expenses incurred of storing and utilizing information in the cloud:
- 2) Assess whether additional connectivity costs would be necessary with suitable service provider availability.
- 3) Determine whether the cloud storage solution offers acceptable security and information control.
- 4) Create an in-house data centre policy, including protocols for cloud storage, significant exposure and use, to facilitate optimal data control and cost influence.

The following are the most prevalent applications for cloud storage:

- 1) Disaster Recovery (DR)
- 2) Cloud Backup
- 3) Archiving of seldom accessed data

Cloud storage services for DevOps are being used by an increasing number of businesses to save capital expenditures and distributed computing has also been found to be of great help in healthcare. Developers may spin up processing and memory services during product design and testing, and subsequently cycle back down after the project is completed. Critical software is increasingly being shifted to the data centre as network operators improve stability and tighten privacy. Furthermore, businesses with strong seasonal swings in data generation activity can leverage online storage to accommodate those spikes of data generation action. On an existing server or client basis, some specialised cloud servers, such as synchronisation and access, could be beneficial for small to mid-sized businesses (SMBs). These data synchronisation attributes are significant because they ensure the stability of regional data editions on the synced server and in the data centre. Revision control and data exchange are typically included [43] [44].

## VIII. CONCLUSION

Advances in cloud storage are accelerating. This study examines and compares the features of several cloud storage services. According to the study, the greatest concerns for company planning are security and large data processing in the cloud. To deal with future challenges, recent performance, adaptability, sustainability, and reliability must be improved. As a result, focus should be placed on virtualization, encryption, and strategic planning [45].

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