

Basics Storage in Cloud Computing

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Abstract - After the great development in information technology, cloud computing has become an urgent necessity, as this technology connects many network systems, whether public, private or hybrid, and thus it will provide great scalability in the basic infrastructure for all computing resources, as the most important service it provides is cloud storage, through which data of various types can be uploaded, downloaded, and retrieved. Cloud storage services are usually accessed via the Internet, where users subscribe to pay-per-use services. Sharing these cloud computing resources will also lead to the emergence of a set of security vulnerabilities, and therefore we will need a set of measures to protect against these cyber-attacks. These data protections in public and private clouds are the main obstacles that limit the use of the cloud. In this paper, a detailed comparison was made about public and private cloud storage and the capabilities provided by each type in addition to the advantages and disadvantages. The study concluded that the private cloud will be widely used compared to the public cloud because it achieves almost the same capabilities of the public cloud with some differences between them in the security field, which in turn will lead us to develop and renew the security measures that must be taken to achieve data preservation.

Keywords: cloud storage, public cloud, private cloud.

I. Introduction

In modern computer science, different types of applications are usually used to store and save data on a set of media in an effective, secure and moderate manner in addition to ensuring the process of accessing this data effectively. In general, data storage is usually on a physical medium temporarily or permanently.

The methods and techniques for storing data in cloud computing are collected, including data management, data retrieval, data authentication methods, in addition to the integrity and availability of data for cloud storage.[1]

The emergence of cloud computing has led to an increase in the ability to process and store large amounts of data. This concept is recently known as cloud computing, where several

systems have been linked and connected in public, private, and hybrid networks in order to provide an infrastructure that can be dynamically updated and developed for the computing resources used. The important features of cloud computing are self-service on demand, high network accessibility, resource pooling, flexibility, and measured service.

In cloud storage data is managed and maintained in addition to being backed up. This service is available to users over the network (Internet) and allows users to store their data over the Internet remotely and on a pay-per-use basis, as there will be no need to purchase storage space before storing the data, but rather the amount of storage space that the data actually reserves is paid for.

In addition, one of the reasons behind the development and innovation of data storage methods and techniques and effectively reducing the security vulnerabilities of stored data is access to the cloud storage service over the Internet in addition to subscription for use.

The ability and efficiency in providing the basic infrastructure (servers, storage) in addition to the services provided is what is called cloud computing, which is usually provided over the Internet through a set of APIs. [2]

Cloud computing refers to the idea of accessing resources conveniently and efficiently without the need to personally maintain the underlying hardware infrastructure. It encompasses a range of computing services, including essential databases, servers, crucial software, data analytics, and networking, all delivered over the Internet.

This approach enables faster deployment, economic scalability, and the availability of flexible resources.

Cloud computing has revamped and modernized the ways in which data is stored and accessed, in addition to hosting and sharing processes that usually allow for employee collaboration. As mentioned above, data is accessed and stored in the cloud via the Internet, which reduces the requirements for hardware and software on the user's side, as the user's data is delivered to a (storage service provider) that stores it in its own data centers. A data center is known as a central repository that is either physical or virtual. There are

many companies that provide many services for storage via the cloud, such as Amazon Web Services, “S3- Simple Storage Service”, Dropbox, Google drive, etc.. Each cloud service vendor has its own way of storing data, where either distributed file systems are used on the network or local files on local drives in cloud computing nodes. Cloud computing also provides a new structure for supervising the storage, management, and analysis of all the huge and ever-growing data. [3]

II. Storage Development and Technological Evolution

- Perforated Paper Tape

The first and oldest storage technology appeared in the year 1725.

- Electric tube counter

In 1946, RCA began research into counting tubes. This type of computer used giant counting tubes, but its disadvantage was its high cost and it quickly disappeared.

- Disc tape

IBM first used disk tapes in 1950 to store data, it achieved great success compared to the previously mentioned types and became the most widely used until 1980.

- Floppy disk

Invented in 1969 to store 80 kilobytes of data, used for reading only, in 1973 a capacity of 256 kilobytes was produced used for reading and writing, in late 1990 a capacity of 250 megabytes appeared.

- Hard Disk

The first production was 500 kilobytes by Hitachi Deskstar 7K500, which is one of the storage devices that are still in the development and modernization phase.

- Compact disks

With the passage of time and the development of information technology, people's need for data storage methods increased as a result of the increase in user data for computers, where Compact disk helped to meet this need. Each compact disk contains up to 680 megabytes of storage space.

- USB flash drive

During both Floppy disk and CD, USB Drive includes storage, erasing and reprogramming operations, as it can store

data from 8 KB to 256 KB at a low cost, and there is also an external USB that can store up to 1 TB. [4]

- Cloud Storage

Storage devices come in different types and complex systems that work together to achieve the data storage process. These systems include the network device, the storage device, the server application software, the public access interface, and the client software. [5]

The structural model of the cloud storage system consists of four layers:

(1) Storage layer

This layer is considered one of the most important layers in cloud storage. Storage devices differ in their types, such as FC and IP, as these devices are spaced out and distributed and connected to the internal network or via the Internet. They also include an integrated system that manages simulation operations in addition to auditing, monitoring, and maintenance operations.

(2) Basic management layer

It is considered an essential and important part of cloud storage, as this layer uses a set of systems to accomplish the common tasks between cloud storage devices, as it provides services and access to data. These systems include group systems, distributed files, and network computing.

(3) Application interface layer

The application interface is also an important part, as dealing with data storage devices and providing services is done through interfaces, which are usually flexible and also scalable.

(4) Access layer

Users usually need permission to access cloud storage systems, which is done through the application interface.

III. Cloud Storage Techniques

1. Storage virtualization

Virtual storage refers to a method of changing storage from the traditional, well-known method, which is the hard disk, to a modern and advanced method called virtual storage. The consumer thinks that he is storing his data as if he is storing it on the hard disk of his personal computer, while the person responsible for storage knows very well that the storage process is virtual, which helps him manage the stored

information in addition to using this information efficiently and quickly. [6]

2. Distributed Storage

When we compare the old traditional storage systems with this new type of storage, we will notice a set of unrestricted and unknown properties that are considered the most important properties of this type, which are low cost in addition to high scalability. The cloud computing system depends on this type of storage, as through backup storage, data reliability is ensured, as the basis of this type of storage is the use of isolated and separate devices in the storage process with the ability to expand these devices and by using a group of servers where the storage load is distributed and shared between these servers. [6]

2.1 Peer Storage System

The idea of this type of storage depends on the storage method in an exchange manner between different storage nodes, where storage can be done on a group of servers or between a group of different computers, in addition to the possibility of forming a network from a mixture of the two types, where the communication process between the storage nodes is done through a protocol that is responsible for the routing process. [7]

2.2 Hadoop Distributed File System (HDFS)

It is a programming-based framework that is usually used for computing operations in addition to storage operations. It is mainly used for distribution purposes and is also scalable in addition to its main feature, which is open source, as its primary function is storage management operations, which are based on what is called distributed computing. The basic work of this type is to complete the partitioning and cutting operations of files in addition to the copying operations that are performed on files for the purpose of dividing them into different blocks, which helps in overcoming errors and preserving data from disasters.

2.3 Traditional RAID Technology

This technology depends on keeping and storing data on different physical devices for the same data, but there is no real guarantee of data safety, especially when the physical devices are not ready for the storage process, as in this case the data will be lost. Therefore, the important thing in this type is that the shorter the time to prepare the physical devices, the better. There are different types of it, which are: RAID 0, RAID 1, RAID 5, RAID 10

3. Network Storage

This type depends on the storage operations that are carried out by different nodes in local networks without intervention by the server, which allows users to access their data in addition to the data processing and management process is carried out centrally, which reduces the cost.

There are four broad networked storage architectures:

DAS (Direct Attached Storage);
SAN (Storage Area Network);
NAS (Network Attached Storage);
SDS (software-defined storage).

3.1 Direct Attached Storage (DAS)

This type depends on the server connecting directly to external physical storage devices through a cable that transfers data. Usually, these two parts are in one place, very similar to regular computers. The technology used in this type is SCSI or FC.

3.2 Storage Area Network (SAN)

This type differs from DAS in that the network storage process is independent and high-speed and the access process is at the block level. There is no allocation of a group of physical devices to a single server, as in this type the physical storage devices are combined with each other and in a single network and all servers in the network are able to access data in all devices, meaning that data sharing in this type is large in addition to the speed that characterizes this type.

DAS was the most widely used before the emergence of problems related to the process of expanding physical storage devices, as each server would deal with a limited number of physical storage devices, which led to the process of forming and creating isolated environments, which led to great difficulty in management and sharing processes.[8]

The invention of this new method in the network storage process solved this problem, as SAN was linked to large groups of physical storage devices, which are usually known as storage silos. This connection is done through a network characterized by high speed and large data sharing between a large number of servers. This type also allowed the process of preserving data in a backup in many places in anticipation of any failure that occurs in the system or any breach in the network, as well as disasters that could lead to data loss, in addition to the possibility of large expansion that can be achieved. The implementation of This type depends on applications such as (IP-SAN), (FC-SAN).

3.3 Network Attached Storage (NAS)

This technology is characterized by the ability to collect data that is usually distributed in different and distant data centers also manages and provides it to users who want to access this data through their own servers. In other words, NAS can be defined as a server that performs special and independent tasks, which is managing storage devices, disk drives and other storage devices through an embedded program that allows strong file sharing, as it is responsible for access and sharing operations as well as file input and output operations, thus facilitating the process of the client server accessing its data as if it were working to access it on their personal computers.

Finally, NAS is considered a device that is connected to the network and has storage capabilities and is not considered a server, we can be said that it has capabilities that may not be present in the specifications of the server itself. Whereas the role of the server is processing operations, while the role of the storage device is storing files.

3.4 Software-defined storage (SDS)

Due to the many requirements for storing data in cloud computing, this new model or technology known as DAS was introduced, which is a new storage model that has significant advantages when compared to traditional storage. The storage method has been changed from hardware-based storage to software-based storage, where each storage unit is managed by a program. This new type also has high expansion capabilities, as instead of adding additional hardware devices to increase capacity, this technology adds new nodes and integrates them with the nodes it contains and on which the program works. Each node includes a server connected to file storage engines, which leads to increased scalability in addition to the additional power that will be added to cloud computing. Therefore, through this technology, we will enjoy easy management of components, and both the user and the manager interact through easy-to-use interfaces for everyone, regardless of the many storage devices used and integrated into this system.

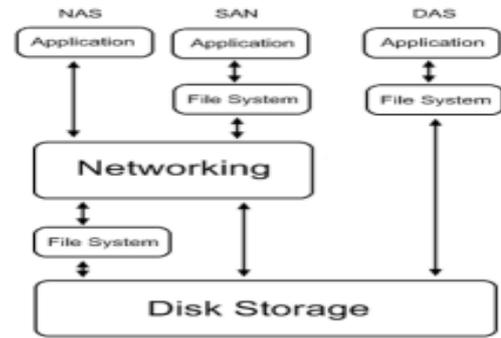
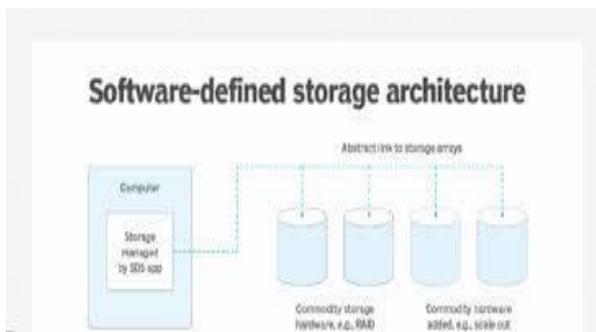


Figure 1: Network Storage

IV. Cloud Deployment Models

In cloud deployment models, the platform, storage, networking, and software infrastructure are provided as a set of services that can be expanded, contracted, and customized. There are three main deployment models:

- Private Cloud

This type of cloud is set up within companies where resources and applications are grouped together and users are enabled to share and use them. It differs from the public cloud in the process of managing these resources, which is the responsibility of the organization. Security in the private cloud is usually better than the public cloud due to its limited exposure to users, which is usually internal, as only the organization and authorized users will have the ability and access to data within this cloud.

A private cloud is entirely dedicated to the needs of a single organization. It can be on or off premises. On premises private cloud located within organization's data center and managed by IT staff hired for this reason, and fully controlled by organization itself. On the other hand, off premises private cloud uses the existing facilities, skills and experience of other companies, such as a colocation hosting facility. [9]

- Public Cloud

It dynamically provides resources following the principle of self-service over the Internet, which is through web applications / web services. As it depends on the method of payment per use and has great flexibility to meet the high or low demand for resources, the public cloud is usually less secure due to its wide exposure to access by users through the Internet, which enables applications and data that can be accessed to malicious electronic attacks.[10]

- Hybrid Cloud

The best description of the hybrid cloud is that it is a private cloud linked to a group of external cloud services and

is managed centrally and provided as a single unit and its security depends on network security. This type of cloud provides greater control for companies and institutions that want to separate sensitive data from unimportant data, thus giving flexibility to institutions, in addition to not being restricted by private cloud resources, thus being more secure, as it allows access to it or its data via the Internet and has an open ability to interact with other systems.

V. Private cloud & public cloud in Details

To define the private cloud in detail, it can be said that it is a single-tenant cloud, as some organizations may need to rent a cloud that is hosted by the service provider instead of being hosted within the organization's data center itself. The cloud is either for a single tenant or a public cloud with multiple tenants. The enterprise cloud, or what is called the private cloud, is the site or building in which the basic infrastructure is formed with the process of managing it for only one organization or institution. The management process is convenient and easy if the organization wants to manage it from within, and it can also be managed from a location outside the site by the service provider.

Therefore, the cloud must be more and more secure in many directions (such as data storage, network). One of these important requirements is preserving privacy in the cloud.[11]

Type of private cloud

The location of the cloud hosting will depend on who is managing the cloud in classifying the four basic types of private clouds, which are:

1. Virtual private cloud

It is a distinctive type of private cloud that provides the advantages of the cloud (power of control + isolated environment) with the help of the resources provided by the public cloud. There are usually some differences between the private cloud and the virtual private cloud, as these two terms are often used without knowing the differences between them. Therefore, we can show that in the traditional private cloud model, the company's IT department will act as a service provider while the employees working in the organization are the tenants. In the virtual private cloud model, the public cloud provider will act as a cloud service provider while the cloud user acts as its tenants. In simple terms, VPC is a hybrid model of CC.

2. Managed private cloud

This type of cloud does not share its infrastructure, as it is called a single-tenant cloud. It is managed by a third-party vendor who provides support, maintenance, and updates, and

sometimes the vendor manages the software applications in the cloud.

3. Hosted private cloud

In this type, the hosted private cloud vendor provides cloud servers in their own data center and is responsible for the security of the cloud, in addition to having the ability to obtain other additional resources in addition to support and increasing scalability on demand.

4. On-Premise private cloud

In this type, it will be necessary to have an internal data center to host the cloud server. This type is characterized by being completely secure, as the hosting and management process is done internally depending on the IT specialists in the organization. The organization will certainly have complete control over the security and components of the cloud, in addition to the ability to expand its own servers. [12]

Private cloud models

As previously mentioned, a private cloud is one that is configured to serve a single organization, and allows the organization to host applications in the cloud with the ability to address security issues related to data security and control. There are two types of them:

1. On-premise private cloud

The internal cloud is the synonym for this type, where the organization owns its own data center, as it provides accurate and uniform operations and protection for the cloud, but it is usually limited in size and scalability, in addition to the fact that the IT staff will be responsible for bearing the financial and operational costs of the physical resources.

2. Externally – hosted private cloud

This type is where an internal or private cloud is hosted by an external cloud service provider, where this host facilitates the provision of the service with high and great privacy, as this type is suitable for organizations that prefer not to use the public cloud or the public cloud infrastructure and do not wish to share their physical resources to avoid the risks of the sharing process, which are the risks related to the security of their data.

Private cloud computing Trade-offs:

1. Security

Because the private cloud is dedicated to a single organization, the design of the devices, data storage

operations, and the network ensure high levels of security so that customers cannot access them in the same data center.

2. Compliance

It cannot be provided in the public cloud, unlike the private cloud, which is usually dedicated to a single function such as devices, storage, and networks, so it is easy to achieve in the private cloud.

3. Customizable

The performance of physical devices, network, and storage can be determined and their work determined in the private cloud.

4. Hybrid deployments

In the event that the organization requests a private server to run an application it has in a high-speed database, it is possible to integrate this device into the private cloud. In this case, there will be a hybrid between virtual servers and private servers, and this cannot be done in the public cloud.

5. Cost and energy efficiency

When using a private cloud, there will be an improvement in the process of allocating resources within the organization by ensuring that resources are available to the departments working within the organization and to other users, and the response process will be high and flexible despite the high material cost compared to public clouds, but it uses computing resources more efficiently in traditional LAN networks. [13]

Challenges of a private Cloud

The private cloud has some restrictions, limitations and challenges that made the use and desire of the user to use the public cloud more attractive to organizations and users.

1. Upfront capital cost

The most important disadvantage of the private cloud is that organizations will need to purchase, configure and manage the cloud infrastructure, which undermines the main goal of cloud computing, as one of the basics of cloud computing is to reduce the cost while providing services in a better way for a simple cost, and this is what cannot be achieved in the private cloud.

2. Time and resource

All organizations wishing to create a private cloud must have the time and expertise, i.e. there will be a large investment in these two factors, in order to build an

infrastructure with automation in order to create and operate the private cloud, the subject will require a lot of investment in time and resources when compared to the public cloud.

3. Size of organization

Building the cloud infrastructure with its requirements does not give a large return compared to the investment made in resources and time when compared to the public cloud, which is characterized by high revenues in the benefits obtained, while small organizations will face great difficulty in providing a private cloud solution. [14]

Public cloud

The owner of the public cloud is a third party that provides services where customers benefit from the low costs of using public cloud services as a result of distributing the cost to all users, allowing each individual user to work on a "pay-per-use" model, which is usually low-cost. One of the advantages of the public cloud is that it is larger in size than the private cloud, providing easy expansion capabilities on demand, in addition to its ability to provide the service to all users using the same infrastructure with high security protection as these works are managed by the service provider.

In the public cloud, services and infrastructure are also provided off-site via the Internet, which provides a high level of efficiency in the use of shared resources. However, they will be more vulnerable to security services compared to the private cloud. [15]

The public cloud model is the most popular and widely used, as services are provided in a virtual structure based on the use of shared physical resources and can be accessed via the Internet, in contrast to the private cloud, which creates a dedicated infrastructure with a cloud platform that is only accessible by the organization that created this cloud.

1. Ultimate scalability

Cloud resources are provided on demand as business requirements are met from the huge resources of the public cloud

2. Cost effective

The public cloud collects large resources and thus greater benefit will be gained from economies of scale as the operation and central management of the basic resources are shared

3. Utility style costing

The public cloud imposes pay-per-use fees where the beneficiary can access the resources whenever he needs them and then pays only for the use. [16]

4. Reliability

When there is a huge number of servers and networks that share the formation of the public cloud, this means that in the event of a failure of one of the physical components, the services will continue to operate without impact, as in the event of a disconnection with a specific data center, there will be no suffering in using cloud services as there is no single point of failure.

5. Flexibility

There are a large number of IaaS, PaaS and SaaS services that can be accessed as a service on any device connected to the Internet. These services meet most of the requirements of cloud computing. Companies can also integrate their own services with the main services of the public cloud to form a hybrid cloud.

6. Location independence

Public cloud services are usually available in any location where the customer is located, provided that there is an Internet network. This provides the opportunity to access the IT infrastructure or collaborate and share documents and files from multiple locations. [17]

VI. Conclusion

Over the Internet, cloud computing provides many services, the most important of which is storage, as the process of providing resources to users has led to a lack of interest in spending on basic infrastructure. The main weaknesses in private cloud security are the large investment in security resources including staff, technology and management, in addition to the fact that with the greater control that the private cloud has, the organization bears full responsibility for securing both data and the underlying infrastructure, which leads to an increased security burden in terms of management, and finally, the private cloud does not enjoy the same frequent security patches and updates that appear in the public cloud, which may make it more vulnerable to new threats.

Finally, the private cloud usually faces a range of threats that come from internal and external users. Internal threats in the cloud occur through individuals within the company who have permission to access cloud services and abuse their access rights to harm the organization. Private clouds often suffer from this type of breach because they are not easily

detectable, and the organization needs to conduct a set of procedures, tests, and implement a set of strategies to detect such breaches. As a result of what the research included, the private cloud will need protection and confidentiality of data don't important less public cloud.

Future Work

Referring to the data breaches that private clouds can face, we recommend conducting studies that discuss new methods and approaches for protecting private clouds from internal and external malicious users.

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