CLOUD COMPUTING

What is cloud computing and why is it important?

Cloud computing

Cloud Computing refers to the on-demand availability of computing resources, such as storage and infrastructure, delivered as services over the internet. Here's why it's important:

1. **Scalability and Flexibility**: Cloud computing allows organizations to scale their resources up or down based on demand. Whether you need more storage, processing power, or other services, the cloud provides flexibility without the need for physical hardware upgrades.
2. **Cost-Efficiency**: With cloud services, you only pay for what you use. There's no need to invest in expensive servers or data centres upfront. This cost-effective model benefits both large enterprises and small businesses.
3. **Reduced IT Burden**: Managing physical servers and infrastructure can be complex and time-consuming. Cloud providers handle maintenance, security, and updates, freeing up your IT team to focus on strategic tasks.
4. **Global Accessibility**: Cloud services are accessible from anywhere with an internet connection. This enables remote work, collaboration, and seamless access to applications and data.
5. **Innovation Acceleration**: Cloud platforms offer a wide range of tools and services, including machine learning, analytics, and databases. Organizations can leverage these capabilities to innovate faster and stay competitive.
6. **Enhanced Security**: Reputable cloud providers invest heavily in security measures, protecting your data from threats. They often have certifications and compliance standards to ensure data privacy.
7. **Disaster Recovery and Backup**: Cloud services provide automated backups and disaster recovery options. Your data is replicated across multiple data centres, reducing the risk of data loss.

Benefits of cloud computing

Cloud computing offers many benefits — so much so that more and more businesses are migrating their infrastructures and data to cloud services and platforms. Some start-ups rely entirely on cloud computing for benefits like:

1. Scalability

The IT needs of every company are different. For example, a big tech company with thousands of employees needs different resources than a start up with only three. Cloud providers are a perfect solution for either company because their services can be scaled to meet their needs.

2. Cost

While the initial migration of existing infrastructure may take planning, money, and time, most businesses see cost savings in using cloud services right away. Since cloud computing resources can be sized to a business's needs, they never pay for more than they use. It's a pay-as-you-go system.

3. Speed

Along with saving time and resources, cloud computing has also sped up software development. Setting up a new development environment or virtual machine on a cloud can be done in seconds with the click of a few buttons. With a traditional data centre, you'd have to purchase, install, and maintain all the required hardware.

4. Productivity

As we explained earlier, eliminating the need for infrastructure maintenance allows your IT staff to focus on business-related tasks. It makes software development, testing, and deployment quicker and easier. It provides a worldwide network of services that can be easily accessed by remote employees.

5. Performance

Because providing modern IT infrastructure is their business, cloud providers keep data centres updated with the latest high-performance hardware and technologies. This enables better connectivity and performance.

6. Security

Cyber security is a big concern of any business. Data breaches can damage an enterprise's revenue, reputation, and even its clients. Cloud services resolve this by managing permissions and access to the services and resources they provide. For example, you could restrict access to an important file to a specific set of users.

7. Disaster recovery

Losing data can be just as bad for a business as having a data breach. Storing data on the cloud ensures that it's always available, even if a laptop or mobile device gets lost or damaged.

What are the types of Cloud Services?

The following are the types of cloud also known as cloud deployment models as follows:
1. Public cloud
2. Private cloud
3. Hybrid cloud
4. Community cloud

1. Public Cloud
- Public clouds are managed by third parties which provide cloud services over the internet to the public, these services are available as pay-as-you-go billing models.
- The fundamental characteristics of public clouds are **multitenancy**. A public cloud is meant to serve multiple users, not a single customer. A user requires a virtual computing environment that is separated, and most likely isolated, from other users.
  Examples: Amazon EC2, IBM, Azure, GCP
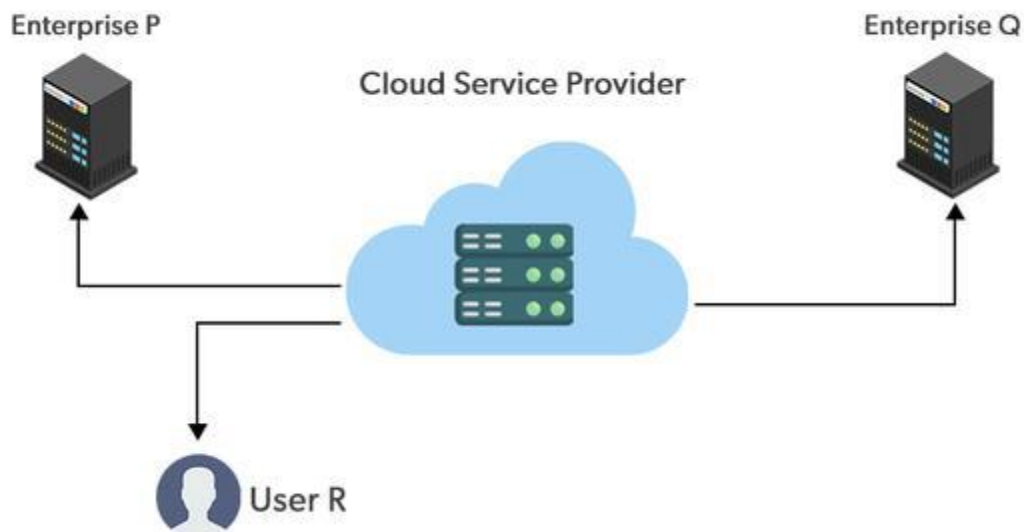
Advantages of Public Cloud

The following are the advantages of public cloud:

- Public cloud is easily able to scale up and down resources as per the demand of traffic and workload. It facilitates with performance optimization and cost efficiency.
- It works on pay-as-you-go cloud model and helps in resolving the investments needs in hardware and infrastructure reducing overall costs.

Disadvantages of using Public Cloud

The following are the disadvantages of Public Cloud:

- It is difficult to trust and maintain data to a third-party provider may raise concerns about control and ownership
- The shared infrastructure of public cloud resources increases the risk of data breaches and unauthorized access. It raises security and privacy concerns.

2. Private cloud

- Private clouds are distributed systems that work on private infrastructure and provide the users with dynamic provisioning of computing resources. Instead of a pay-as-you-go model in private clouds, there could be other schemes that manage the usage of the cloud and proportionally billing of the different departments or sections of an enterprise. Private cloud providers are HP Data Centers, Ubuntu, Elastic-Private cloud, Microsoft, etc.
  Examples: VMware cloud Suite, Open Stack, Cisco Secure Cloud, Dell Cloud Solutions.
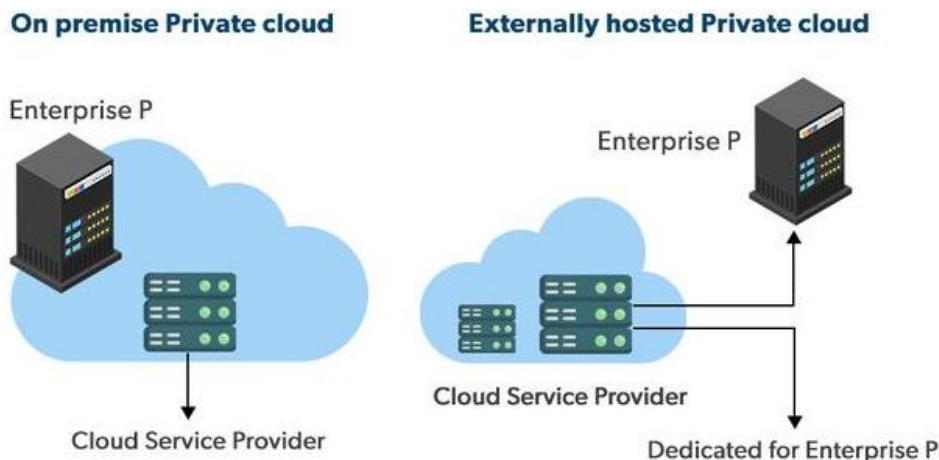

Advantages of Private Cloud

- **Customer information protection:** In the private cloud security concerns are less since customer data and other sensitive information do not flow out of private infrastructure.
- **Infrastructure ensuring SLAs:** Private cloud provides specific operations such as appropriate clustering, data replication, system monitoring, and maintenance, disaster recovery, and other uptime services.

Disadvantages of Private Cloud
- **The restricted area of operations:** Private cloud is accessible within a particular area. So the area of accessibility is restricted.
- **Expertise requires:** In the private cloud security concerns are less since customer data and other sensitive information do not flow out of private infrastructure. Hence skilled people are required to manage & operate cloud services.

3. Hybrid cloud
- A hybrid cloud is a heterogeneous distributed system formed by combining facilities of the public cloud and private cloud. For this reason, they are also called **heterogeneous clouds.** **Examples:** AWS Outposts, Azure Stack, Google Anthon, IBM Cloud Satellite, Oracle Cloud at Customer
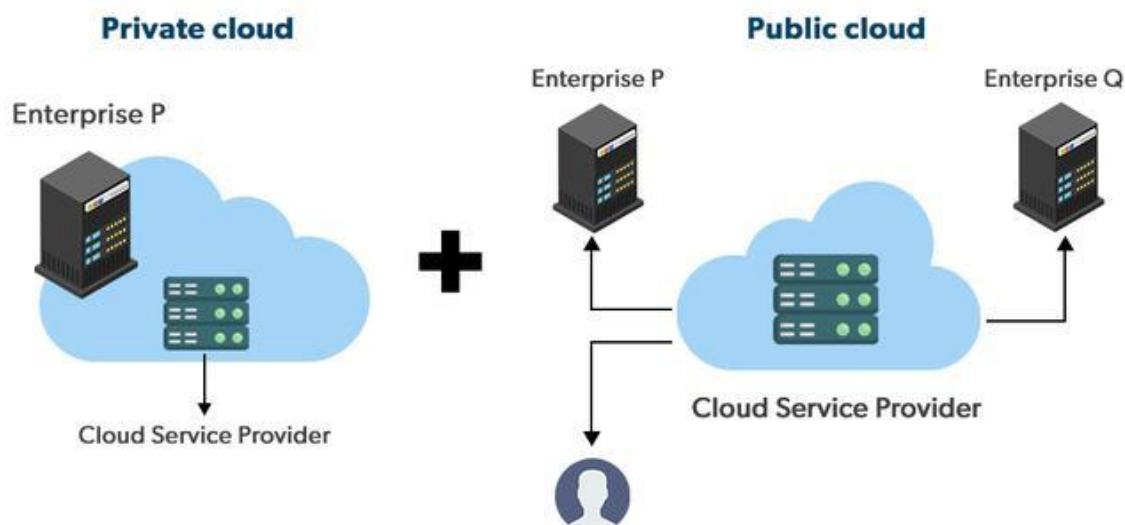
Advantages of using Hybrid cloud
The following are the advantages of using Hybrid Cloud:
- Hybrid cloud is available at a cheap cost than other clouds because it is formed by a distributed system.
- It works comes up with working fast with lower cost and facilitates in reducing the latency of the data transfer process.

Disadvantages of Using Hybrid Cloud
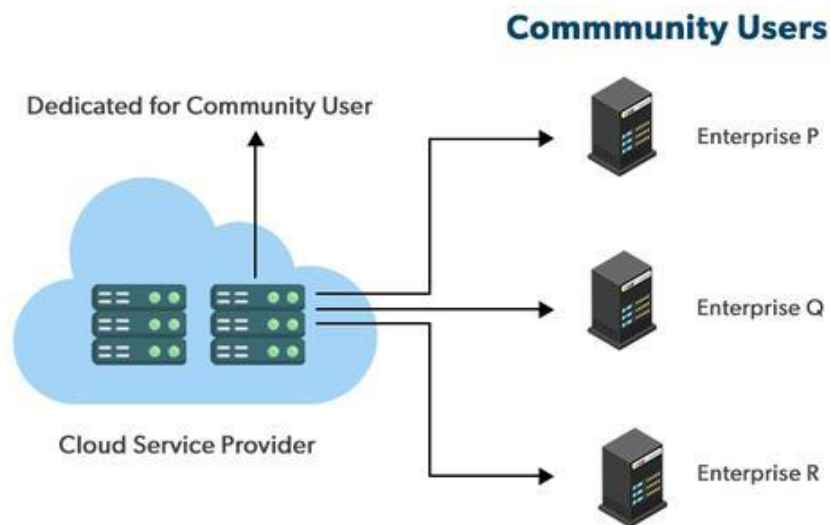The following are the disadvantages of using Hybrid Cloud:
- It's possible that businesses lack the internal knowledge necessary to create such a hybrid environment. Managing security may also be more challenging. Different access levels and security considerations may apply in each environment.

- Managing a hybrid cloud may be more difficult. With all of the alternatives and choices available today, not to mention the new PaaS components and technologies that will be Released every day going forward, public cloud and migration to public cloud are already complicated enough. It could just feel like a step too far to include hybrid.

4. Community Cloud
- Community clouds are distributed systems created by integrating the services of different clouds to address the specific needs of an industry, a community, or a business sector. But sharing responsibilities among the organizations is difficult.
  Examples: Cloud Sigma, Next cloud, Sinology C2, Own Cloud, Stratoscale

Advantages of Using Community Cloud
The following are the advantages of using Community Cloud:
- Because the entire cloud is shared by numerous enterprises or a community, community clouds are cost-effective.
- Because it works with every user, the community cloud is adaptable and scalable. Users can alter the documents according to their needs and requirements.

Disadvantages of using Community Cloud
The following are the disadvantages of using Community Cloud:
- Not all businesses should choose community cloud.
- Gradual adoption of data
- It's challenging for corporations to share duties.

Types of Cloud Computing Services?

The following are the types of Cloud Computing:

1. Infrastructure as a Service (IaaS)
2. Platform as a Service (PaaS)
3. Software as a Service (SaaS)
4. Function as as Service (FaaS)

1. Infrastructure as a Service (IaaS)

- **Flexibility and Control:** IaaS comes up with providing virtualized computing resources such as VMs, Storage, and networks facilitating users with control over the Operating system and applications.
- **Reducing Expenses of Hardware**: IaaS provides business cost savings with the elimination of physical infrastructure investments making it cost-effective.
- **Scalability of Resources:** The cloud provides in scaling of hardware resources up or down as per demand facilitating optimal performance with cost efficiency.

2. Platform as a Service (PaaS)

- **Simplifying the Development:** Platform as a Service offers application development by keeping the underlying Infrastructure as an Abstraction. It helps the developers to completely focus on application logic (Code) and background operations are completely managed by the AWS platform.
- **Enhancing Efficiency and Productivity:** PaaS lowers the Management of Infrastructure complexity, speeding up the Execution time and bringing the updates quickly to market by streamlining the development process.
- **Automation of Scaling:** Management of resource scaling, guaranteeing the program's workload efficiency is ensured by PaaS.

3. SaaS (software as a service)

- **Collaboration and Accessibility:** Software as a Service (SaaS) helps users to easily access applications without having the requirement of local installations. It is fully managed by the AWS Software working as a service over the internet encouraging effortless cooperation and ease of access.
- **Automation of Updates:** SaaS providers manage the handling of software maintenance with automatic latest updates ensuring users gain experience with the latest features and security patches.
- **Cost Efficiency:** SaaS acts as a cost-effective solution by reducing the overhead of IT support by eliminating the need for individual software licenses.

4. Function as a Service (FaaS)

- **Event-Driven Execution:** FaaS helps in the maintenance of servers and infrastructure making users worry about it. FaaS facilitates the developers to run code as a response to the events.
- **Cost Efficiency:** FaaS facilitates cost efficiency by coming up with the principle "Pay as per you Run" for the computing resources used.
- **Scalability and Agility:** Serveries Architectures scale effortlessly in handing the workloads promoting agility in development and deployment.

Comparing Horizontal vs Vertical Scaling

To better understand the differences between horizontal and vertical scaling, let's take a closer look at each method and compare them side by side.

Aspect	Horizontal Scaling	Vertical Scaling
Definition	Adding more machines or instances	Upgrading existing hardware or software
Cost	Typically cost-effective since you can use commodity hardware	Often more expensive due to the need for high-end hardware
Scalability	Easily scalable by adding more nodes or instances	Limited by the capacity of a single machine
Fault Tolerance	Provides inherent fault tolerance since multiple instances can handle failures	Single point of failure can lead to reduced fault tolerance
Performance	Can potentially achieve high performance through parallel processing	Performance improvements depend on the capabilities of the upgraded hardware
Complexity	May require additional configuration for load balancing and data synchronization	Simpler to implement but can become complex with very large, powerful servers

Issues in Cloud Computing

1. Privacy: The user data can be accessed by the host company with or without permission. The service provider may access the data that is on the cloud at any point in time. They could accidentally or deliberately alter or even delete information.

2. Compliance: There are many regulations in places related to data and hosting. To comply with regulations (Federal Information Security Management Act, Health Insurance Portability and Accountability Act, etc.) the user may have to adopt deployment modes that are expensive.

3. Security: Cloud-based services involve third-party for storage and security. Can one assume that a cloud-based company will protect and secure one's data if one is using their services at a very low or for free? They may share users' information with others. Security presents a real threat to the cloud.

4. Sustainability: This issue refers to minimizing the effect of cloud computing on the environment.But other than nature's favors, would these countries have enough technical infrastructure to sustain the high-end clouds?

5. Abuse: While providing cloud services, it should be ascertained that the client is not purchasing the services of cloud computing for a nefarious purpose. In 2009, a banking Trojan illegally used the popular Amazon service as a command and control channel that issued software updates and malicious instructions to PCs that were infected by the malware So the hosting companies and the servers should have proper measures to address these issues.

6. Higher Cost: If you want to use cloud services uninterruptedly then you need to have a powerful network with higher bandwidth than ordinary internet networks, and also if your organization is broad and large so ordinary cloud service subscription won't suit your Organization.This is a major problem before small organizations that restricts them from diving into cloud technology for their business.

7. Recovery of lost data in contingency: Before subscribing any cloud service provider goes through all norms and documentations and check whether their services match your requirements and sufficient well-maintained resource infrastructure with proper upkeeping.If you are able to choose proper cloud service then in the future you don't need to worry about the recovery of lost data in any contingency.

8. Upkeeping (management) of Cloud: Maintaining a cloud is a herculean task because a cloud architecture contains a large resources infrastructure and other challenges and risks as well, user satisfaction, etc. So, sometimes it becomes hard to decide how much should be charged in case the user wants scalability and extend the services.

9. Lack of resources/skilled expertise: One of the major issues that companies and enterprises are going through today is the lack of resources and skilled employees. Every second organization is seeming interested or has already been moved to cloud services. These challenges can only be minimized through additional training of IT and development staff.

10. Pay-per-use service charges: Cloud computing services are on-demand services a user can extend or compress the volume of the resource as per needs. It is difficult to define a certain pre-defined cost for a particular quantity of services Summer-time is here and so is the time to skill-up! More than 5,000 learners have now completed their journey from **basics of DSA to advanced level development programs** such as Full-Stack, Backend Development, and Data Science.

Why is Cloud Computing Security Important?

Traditional computing systems offer a great approach to transmitting data but lack a security system that is eventually unable to control data loss and data integrity which is very important in computing systems.

The cloud model is important in several ways:

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

Cloud Computing Pricing Models – An Overview

Cloud providers offer different options for their customers in terms of pricing. The most common pricing models at cloud providers are:
- On-demand pricing
- Spot pricing
- Reserved instance pricing
- Volume discounts or tier based pricing

On-demand Pricing

On-demand or pay-per-use pricing is the simplest and mostly the default option at cloud providers. Customers pay exactly what they use. However, not all on-demand pricing modes are created equal. On the fine lines of the pricing options, the granularity can vary drastically from one provider to another. Almost all are billed with an hourly unit, with some charging for full hours - every hour started is due - and others with down to the minute or second. While most are converging to minute or second granularity, some still have minimum billing periods of first 5-minutes for example. At Exoscale, instance pricing is based on an hourly rate with per second granularity and no minimum billing period.

Spot Pricing

Spot pricing or instances are basically an auction-based system. Customers bid for instances and as soon as the market price drops below the bid, the instance is "bought" at the market price (not the bidding price). This means that this type of pricing needs a lot of supervision, and the bidder needs to wait for the market price to reach the bid. This option is possible for workloads that are fault-tolerant and flexible or are non-critical workloads like test environments. Spot should never be used on its own, it is mostly a combination with on-demand instances required.

Reserved Instance Pricing

With reserved instances customers commit in many ways. First, a commitment to a time frame, mostly between one and three years, is required. The longer the commitment, the higher the cost savings. Second, a commitment to a certain instance type and a certain zone. The discounted rate is therefore bound to the chosen instance. Flexibility is inherent to cloud infrastructure. Resource requirements change quickly. In case an instance is not needed anymore or needs a larger or smaller one, the customer still has to pay for it with reserved instances.

Volume Discount

A volume discount is a well-designed option for customers with fixed high workloads. Customers commit to a certain minimum usage per month and receive in exchange a discounted rate. The commitment requires a minimum period of 12 months but can be enhanced further.
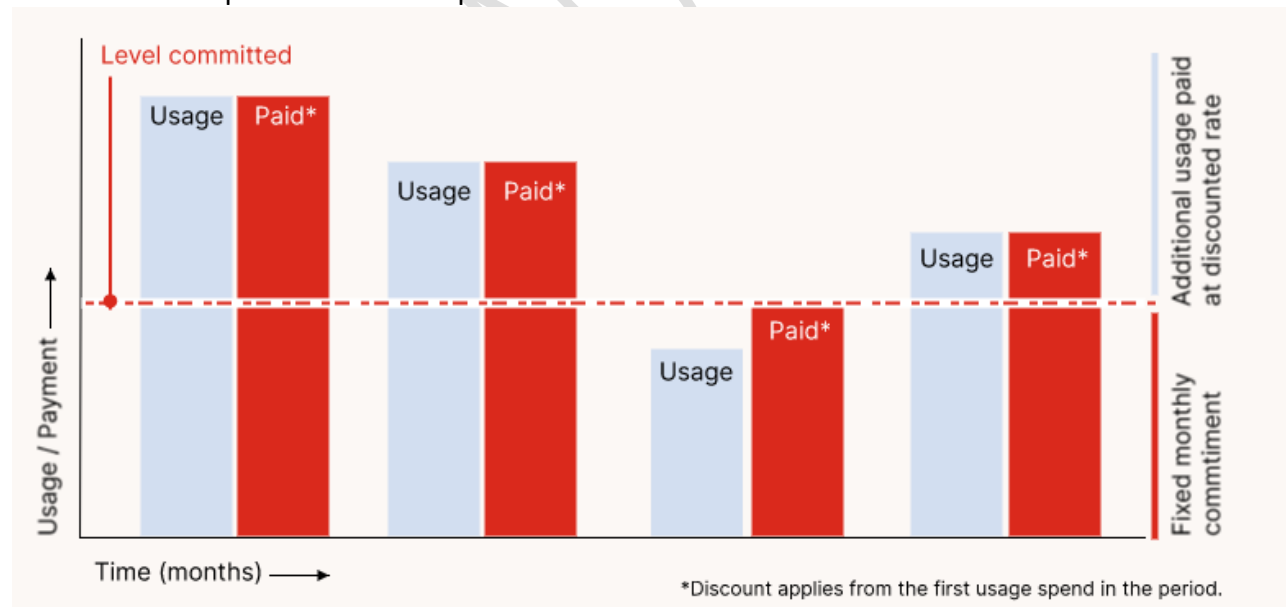
At Exoscale we offer the volume discount for all Exoscale products in all available zones. In contrast to reserved instances or spot instances, this option does not require supervision and enables cost predictability. Also, no hidden costs will appear on the customer's bill, like additional

costs for traffic. At some cloud providers this option requires upfront payments, at Exoscale we do not require any upfront payment on volume discounts.