Unit-1

Grid Computing

Grid Computing can be defined as a network of computers working together to perform a task that would rather be difficult for a single machine. All machines on that network work under the same protocol to act as a virtual supercomputer. The task that they work on may include analyzing huge datasets or simulating situations that require high computing power. Computers on the network contribute resources like processing power and storage capacity to the network.

Grid Computing is a subset of distributed computing, where a virtual supercomputer comprises machines on a network connected by some bus, mostly Ethernet or sometimes the Internet. It can also be seen as a form of Parallel Computing where instead of many CPU cores on a single machine, it contains multiple cores spread across various locations. The concept of grid computing isn't new, but it is not yet perfected as there are no standard rules and protocols established and accepted by people.

Working:

A Grid computing network mainly consists of these three types of machines

1. **Control Node:** A computer, usually a server or a group of servers which administrates the whole network and keeps the account of the resources in the network pool.
2. **Provider:** The computer contributes its resources to the network resource pool.
3. **User:** The computer that uses the resources on the network.

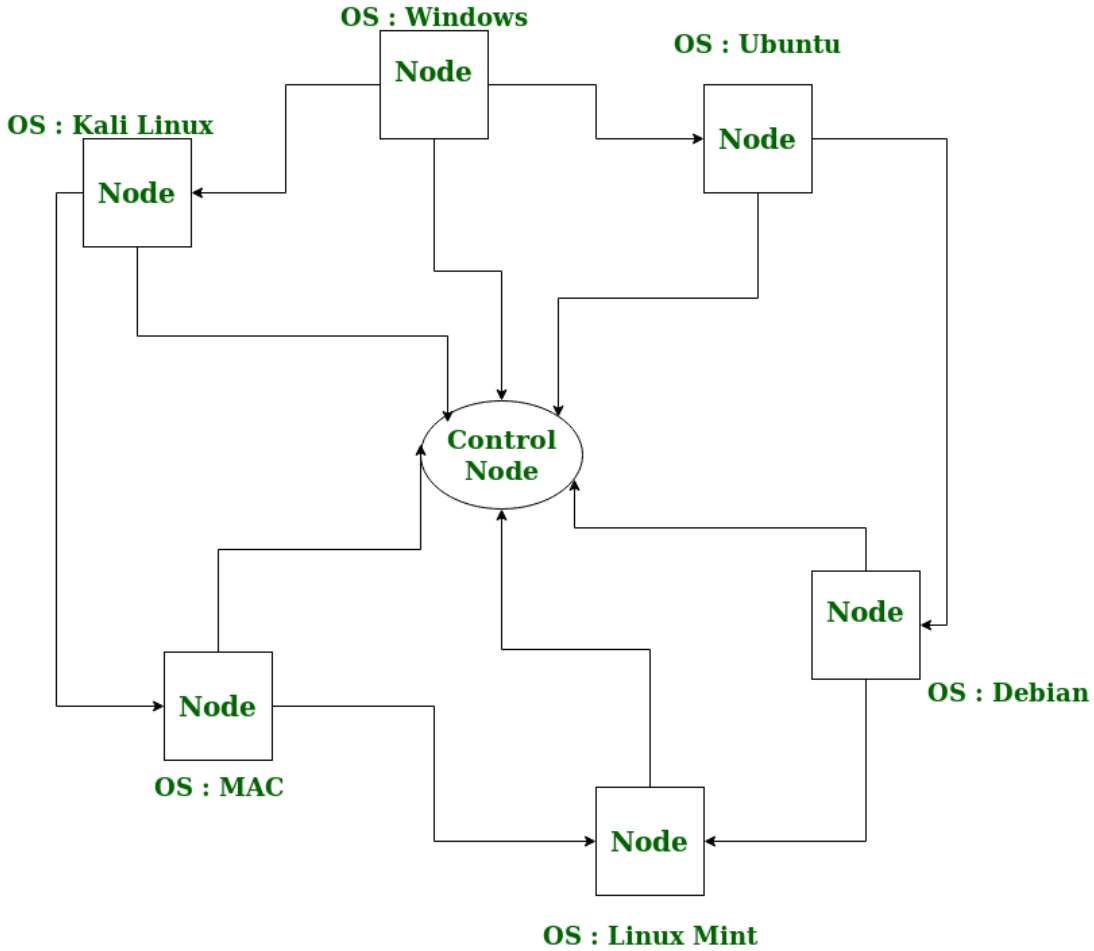
When a computer makes a request for resources to the control node, the control node gives the user access to the resources available on the network. When it is not in use it should ideally contribute its resources to the network. Hence a normal computer on the node can swing in between being a user or a provider based on its needs. The nodes may consist of machines with similar platforms using the same OS called homogeneous networks, else machines with different platforms running on various different OSs called heterogeneous networks. This is the distinguishing part of grid computing from other distributed computing architectures.

For controlling the network and its resources a software/networking protocol is used generally known as **Middleware**. This is responsible for administrating the network and the control nodes are merely its executors. As a grid computing system should use only unused resources of a computer, it is the job of the control node that any provider is not overloaded with tasks.

Another job of the middleware is to authorize any process that is being executed on

the network. In a grid computing system, a provider gives permission to the user to run anything on its computer, hence it is a huge security threat to the network. Hence a middleware should ensure that there is no unwanted task being executed on the network.

The meaning of the term Grid Computing has changed over the years, according to "The Grid: Blueprint for a new computing infrastructure" by Ian Foster and Carl Kesselman published in 1999, the idea was to consume computing power like electricity is consumed from a power grid. This idea is similar to the current concept of cloud computing, whereas now grid computing is viewed as a distributed collaborative network. Currently, grid computing is being used in various institutions to solve a lot of mathematical, analytical, and physics problems.



Topology in Grid Computing

Advantages of Grid Computing:

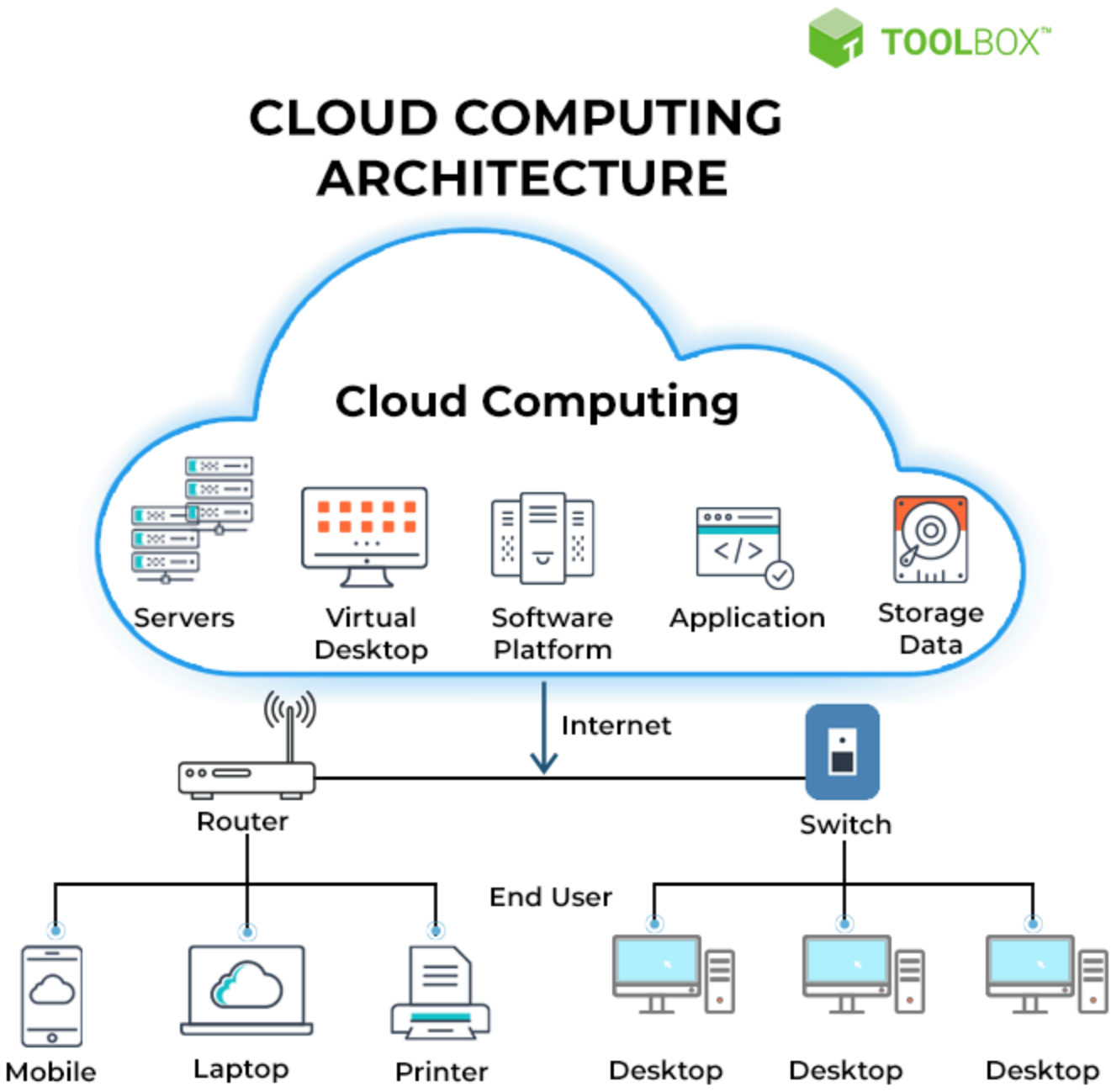
1. It is not centralized, as there are no servers required, except the control node which is just used for controlling and not for processing.
2. Multiple heterogeneous machines i.e. machines with different Operating Systems can use a single grid computing network.
3. Tasks can be performed parallelly across various physical locations and the users don't have to pay for them (with money).

Disadvantages of Grid Computing:

1. The software of the grid is still in the involution stage.
2. A super-fast interconnect between computer resources is the need of the hour.
3. Licensing across many servers may make it prohibitive for some applications.
4. Many groups are reluctant with sharing resources.
5. Trouble in the control node can come to halt in the whole network.

What Is Cloud Computing?

Cloud computing refers to the use of hosted services, such as data storage, servers, databases, networking, and software over the internet. The data is stored on physical servers, which are maintained by a cloud service provider. Computer system resources, especially data storage and computing power, are available on-demand, without direct management by the user in cloud computing.



Cloud Computing Architecture

Instead of storing files on a storage device or hard drive, a user can save them on cloud, making it possible to access the files from anywhere, as long as they have access to the web. The services hosted on cloud can be broadly divided into infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), and software-as-a-service (SaaS). Based on the deployment model, cloud can also be classified as public, private, and hybrid cloud.

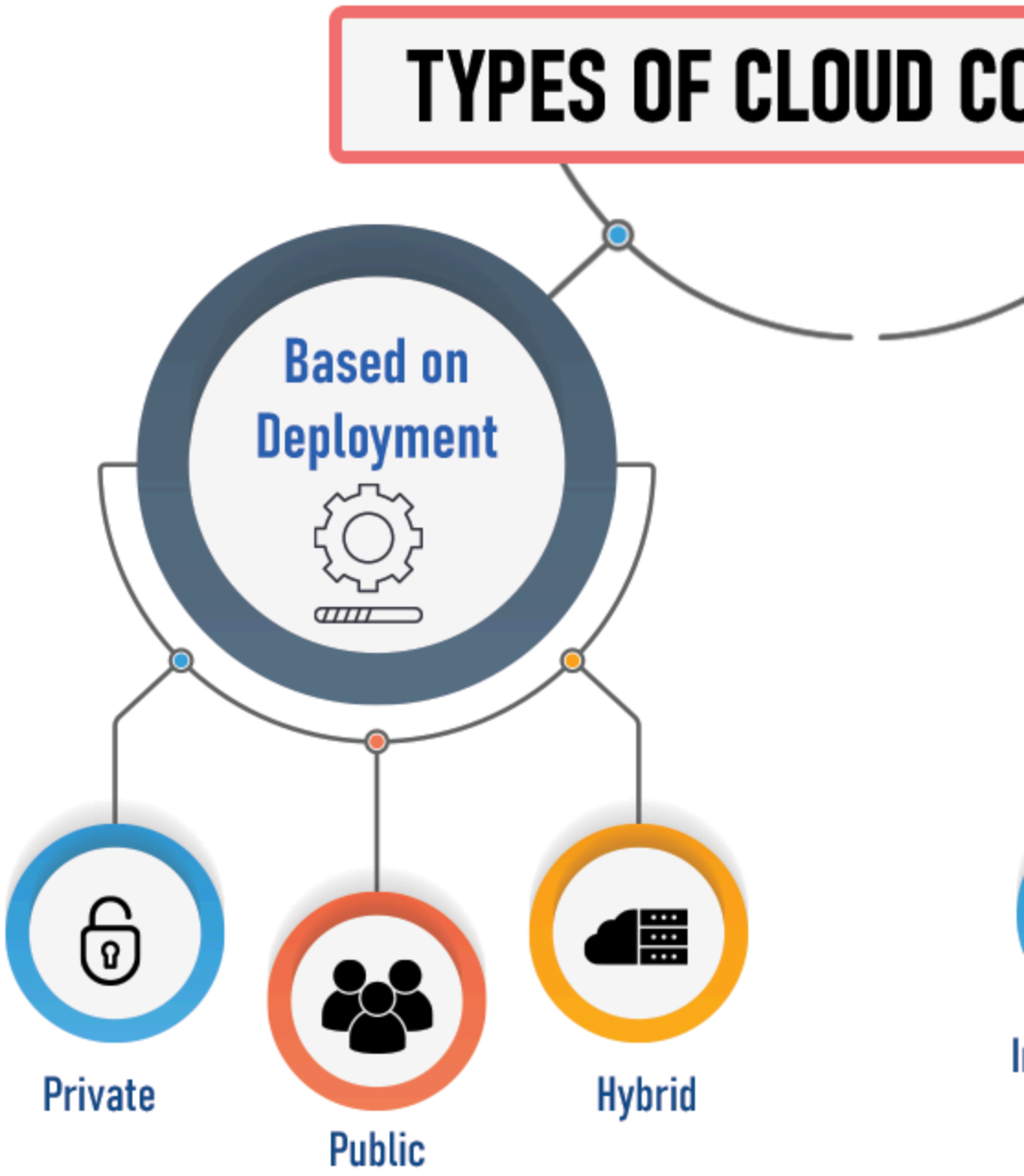
Further, cloud can be divided into two different layers, namely, front-end and back-end. The layer with which users interact is called the front-end layer. This layer enables a user to access the data that has been stored in cloud through cloud computing software.

The layer made up of software and hardware, i.e., the computers, servers, central servers, and databases, is the back-end layer. This layer is the primary component of cloud and is entirely responsible for storing information securely. To ensure seamless connectivity between devices linked via cloud computing, the central servers use a software called middlewareOpens a new window that acts as a bridge between the database and applications.

Also Read: What Is Cloud Computing Security? Definition, Risks, and Security Best Practices

Types of Cloud Computing

Cloud computing can either be classified based on the deployment model or the type of service. Based on the specific deployment model, we can classify cloud as public, private, and hybrid cloud. At the same time, it can be classified as infrastructure-as-a-service (IaaS), platform-as-a-service (PaaS), and software-as-a-service (SaaS) based on the service the cloud model offers.



Types of Cloud Computing

Private cloud

In a private cloud, the computing services are offered over a private IT network for the dedicated use of a single organization. Also termed internal, enterprise, or corporate cloud, a private cloud is usually managed via internal resources and is not accessible to anyone outside the organization. Private cloud computing provides all the benefits of a public cloud, such as self-service, scalability, and elasticity, along with additional control, security, and customization.

Private clouds provide a higher level of security through company firewalls and internal hosting to ensure that an organization's sensitive data is not accessible to third-party providers. The drawback of private cloud, however, is that the organization becomes responsible for all the management and

maintenance of the data centers, which can prove to be quite resource-intensive.

Public cloud

Public cloud refers to computing services offered by third-party providers over the internet. Unlike private cloud, the services on public cloud are available to anyone who wants to use or purchase them. These services could be free or sold on-demand, where users only have to pay per usage for the CPU cycles, storage, or bandwidth they consume.

Public clouds can help businesses save on purchasing, managing, and maintaining on-premises infrastructure since the cloud service provider is responsible for managing the system. They also offer scalable RAM and flexible bandwidth, making it easier for businesses to scale their storage needs.

Hybrid cloud

Hybrid cloud uses a combination of public and private cloud features. The "best of both worlds" cloud model allows a shift of workloads between private and public clouds as the computing and cost requirements change. When the demand for computing and processing fluctuates, hybrid cloudOpens a new window allows businesses to scale their on-premises infrastructure up to the public cloud to handle the overflow while ensuring that no third-party data centers have access to their data.

In a hybrid cloud model, companies only pay for the resources they use temporarily instead of purchasing and maintaining resources that may not be used for an extended period. In short, a hybrid cloud offers the benefits of a public cloud without its security risks.

Based on the service model, cloud can be categorized into IaaS (Infrastructure-as-a-Service), PaaS (Platform-as-a-Service), and SaaS (Software-as-a-Service). Let's take a look at each one.

Infrastructure as a service (IaaS)

Infrastructure as a service or IaaS is a type of cloud computing in which a service provider is responsible for providing servers, storage, and networking

over a virtual interface. In this service, the user doesn't need to manage the cloud infrastructure but has control over the storage, operating systems, and deployed applications.

Instead of the user, a third-party vendor hosts the hardware, software, servers, storage, and other infrastructure components. The vendor also hosts the user's applications and maintains a backup.

Platform as a service (PaaS)

Platform as a service or PaaS is a type of cloud computing that provides a development and deployment environment in cloud that allows users to develop and run applications without the complexity of building or maintaining the infrastructure. It provides users with resources to develop cloud-based applications. In this type of service, a user purchases the resources from a vendor on a pay-as-you-go basis and can access them over a secure connection.

PaaS doesn't require users to manage the underlying infrastructure, i.e., the network, servers, operating systems, or storage, but gives them control over the deployed applications. This allows organizations to focus on the deployment and management of their applications by freeing them of the responsibility of software maintenance, planning, and resource procurement.

Software as a service (SaaS)

SaaS or software as a service allows users to access a vendor's software on cloud on a subscription basis. In this type of cloud computing, users don't need to install or download applications on their local devices. Instead, the applications are located on a remote cloud network that can be directly accessed through the web or an API.

In the SaaS model, the service provider manages all the hardware, middleware, application software, and security. Also referred to as ‘hosted software’ or ‘on-demand software’, SaaS makes it easy for enterprises to streamline their maintenance and support.

Key Benefits and Challenges for Enterprises

The most important reason why cloud computing is growing rapidly is the various benefits it offers. It saves businesses the time and resources required

to set up full-fledged physical IT infrastructure. Let’s look at all the benefits cloud offers:

- **Reduced costs:** Maintaining IT systems requires big outlays of capital, something that cloud helps reduce. By using the resources provided by the cloud provider, businesses avoid the need to purchase expensive infrastructure, substantially reducing their
- Expenditure. Cloud providers work on the pay-as-you-go model, which means businesses only pay for the services they use, further reducing costs.
- **Scalability:** Cloud allows organizations to grow their users from merely a few to thousands in a very short time. Depending on the need, a business can scale their storage needs up or down, allowing organizations to be flexible.
- **Flexibility and collaboration:** Since the data on cloud can be accessed directly via the internet, it gives employees the ability to work from anywhere, anytime. Cloud gives you the freedom to set up your virtual office anywhere you are. It also allows teams to work on a project across locations by giving them access to the same files as third-party vendors.

- **Business continuity:** Cloud safely stores and protects your data in the event of an outage or crisis. This makes it easier to resume work once the systems are up and running again.
- **Competitive edge:** Cloud takes care of various business aspects, such as maintaining the IT infrastructure, licensing software, or training personnel to manage your data. It, therefore, gives you an edge over your competitors since the time and resources you invest are minimal.

Talking about the benefits of cloud computing, Cloud Expert, Lucy Thorpe from InCloud SolutionsOpens a new window , says, “Cloud technology is ideal for growing companies because it allows you to scale up your computing capacity as you grow — adding in extra users and opening up new functionality. So, for example, if a company buys a software in a box solution from a cloud service provider, they can start out by using the financials element to speed up basic accounting processes and then move on to other parts of the system such as HR, CRM, and Project Management.”

Now let’s move on to discuss some challenges of cloud computing.

The biggest challenge of cloud computing is the security concerns associated with the technology. Although cloud service providers assure you of implementing the best security standards and industry certifications, there’s always a risk while storing your data on cloud.

- **Downtime:** Almost every cloud user will tell you that outages tops their list of cloud computing challengesOpens a new window . At times, cloud service providers may get overwhelmed due to the huge number of clients they provide services to each day. This may lead to technical outages, due to which your applications may temporarily experience some downtime.
- **Internet connection dependency:** A user may not be able to access the data on cloud without a good internet connection and a compatible device. Moreover, using public Wi-Fi to access your files could pose a threat if the right security measures are not taken.

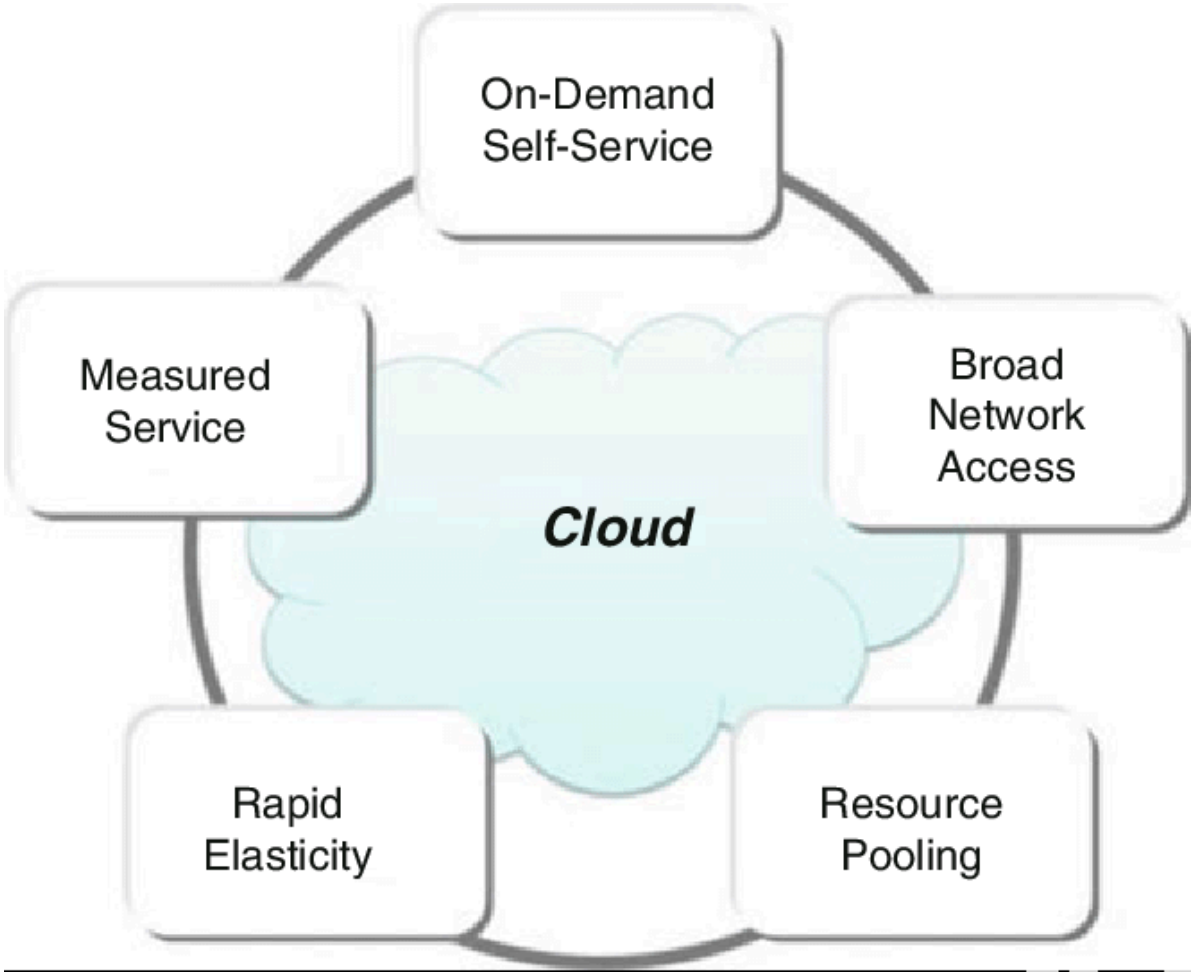
- **Financial commitment:** Cloud providers use a pay-as-you-go pricing model. However, businesses need to give a monthly or annual financial commitment for most subscription plans. This needs to be factored into their operating costs.
- **Security risks:** Even if your cloud service provider promises you that they have the most reliable security certifications, there's always a chance of losing your data. With hackers increasingly targeting cloud storage to gain access to sensitive business data, this might be an even greater concern, for which the appropriate measures need to be taken.
- **Limited access:** A user may have minimal control since the cloud service provider owns and manages the infrastructure. The user would only be able to manage applications and not the backend infrastructure. Crucial tasks, such as firmware management, may not be passed to the user at all. You always have to trust a third-party vendor to ensure security and take care of your data.

Characteristics of Cloud Computing

There are many characteristics of Cloud Computing here are few of them :

1. **On-demand self-services:** The Cloud computing services does not require any human administrators, user themselves are able to provision, monitor and manage computing resources as needed.
2. **Broad network access:** The Computing services are generally provided over standard networks and heterogeneous devices.
3. **Rapid elasticity:** The Computing services should have IT resources that are able to scale out and in quickly and on as needed basis. Whenever the user require services it is provided to him and it is scale out as soon as its requirement gets over.
4. **Resource pooling:** The IT resource (e.g., networks, servers, storage, applications, and services) present are shared across multiple applications and occupant in an uncommitted manner. Multiple clients are provided service from a same physical resource.
5. **Measured service:** The resource utilization is tracked for each application and occupant, it will provide both the user and the resource provider with an account of what has been used. This is done for various reasons like monitoring billing and effective use of resource.
6. **Multi-tenancy:** Cloud computing providers can support multiple tenants (users or organizations) on a single set of shared resources.
7. **Virtualization:** Cloud computing providers use virtualization technology to abstract underlying hardware resources and present them as logical resources to users.

8. **Resilient computing:** Cloud computing services are typically designed with redundancy and fault tolerance in mind, which ensures high availability and reliability.
9. **Flexible pricing models:** Cloud providers offer a variety of pricing models, including pay-per-use, subscription-based, and spot pricing, allowing users to choose the option that best suits their needs.
10. **Security:** Cloud providers invest heavily in security measures to protect their users' data and ensure the privacy of sensitive information.
11. **Automation:** Cloud computing services are often highly automated, allowing users to deploy and manage resources with minimal manual intervention.
12. **Sustainability:** Cloud providers are increasingly focused on sustainable practices, such as energy-efficient data centers and the use of renewable energy sources, to reduce their environmental impact.



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Business and IT Perceptive

Business Benefits & Limitations

Cloud computing is still in its infancy and is an emerging technology. Organizations and businesses are trying out and benefiting from the services of the cloud. However, there are certain limitations to this cloud computing model as well. Let's do a comparison on the benefits and limitations of the cloud computing.

Benefits	Limitations
Reduced IT costs – This is the primary advantage of opting for a cloud model.	Security Threat – This is the primary risk of having data on the cloud. You have to depend on the vendor's security applications. Your data might not be that secure when passed over the cloud, especially a public cloud.
Scalability and Performance – The performance and scalability of applications are considerable improved, when on the cloud, due to the constant maintenance and upgrades.	Technical Downtimes – Even a cloud would experience technical issues and downtimes. You would be helpless in these scenarios, as you would have to wait until the issue is resolved to access the services again.
Business Continuity – Business continuity is not impacted in the case of natural disasters or system problems. The data is backed up on the cloud.	Vendor Lock-in – Once you decide on a vendor and start using the services, changing a vendor would be the most difficult task. The effort to move the huge data across to a different vendor's cloud would be a highly risky and time consuming process.
Quick deployment and Ease of Use – The application or software is already installed on the cloud. For the business, it is just a matter of accessing it.	Low degree of control – You would not have access to the different layers of the applications. For most of the applications, you would have access only on the top layer. So you would not have the option to customize heavily or even do basic troubleshooting at times as the services are being used by other end users as well.

Automatic updates and upgrades – The vendor takes care of the updates and upgrades required to the applications and software. Very often, these are seamlessly done without impacting business.	Prone to attacks – Being on the cloud, especially the public cloud, your data is always at the risk of being prone to attacks. You might have to have different service models to segregate the highly confidential data that must not be conveyed over the public cloud.
Unlimited Storage – Being on a cloud, the storage options are definitely more and advanced compared to the physical storage installations that would be done at an organization's premises.	Uninterrupted Internet Connection – Unlike an internal application, the cloud services are from a third party and to access these, you would always require a high connectivity Internet connection. The performance of the applications are impacted if your Internet connection is slow.

public verses private clouds

Below is a table of differences between Public Cloud and Private Cloud is as follows:

Public Cloud	**Private Cloud**
Cloud Computing infrastructure is shared with the public by service providers over the internet. It supports multiple customers i.e, enterprises.	Cloud Computing infrastructure is shared with private organizations by service providers over the internet. It supports one enterprise.
Multi-Tenancy i.e, Data of many enterprises are stored in a shared environment but are isolated. Data is shared as per rule, permission, and security.	Single Tenancy i.e, Data of a single enterprise is stored.

Public Cloud	**Private Cloud**
Cloud service provider provides all the possible services and hardware as the user-base is the world. Different people and organizations may need different services and hardware. Services provided must be versatile.	Specific services and hardware as per the need of the enterprise are available in a private cloud.
It is hosted at the Service Provider site.	It is hosted at the Service Provider site or enterprise.
It is connected to the public internet.	It only supports connectivity over the private network.
Scalability is very high, and reliability is moderate.	Scalability is limited, and reliability is very high.
Cloud service provider manages the cloud and customers use them.	Managed and used by a single enterprise.
It is cheaper than the private cloud.	It is costlier than the public cloud.
Security matters and dependent on the service provider.	It gives a high class of security.

Public Cloud	Private Cloud
Performance is low to medium.	Performance is high.
It has shared servers.	It has dedicated servers.
Example: Amazon web service (AWS) and Google AppEngine etc.	Example: Microsoft KVM, HP, Red Hat & VMWare etc.

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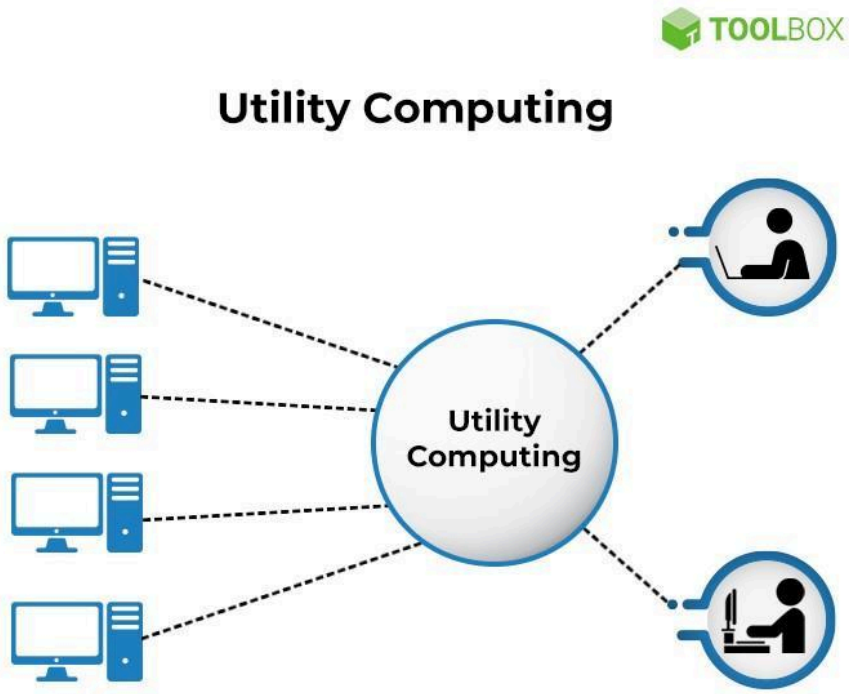
Utility computing is defined as a service provisioning model that offers computing resources to clients as and when they require them on an on-demand basis. The charges are exactly as per the consumption of the services provided, rather than a fixed charge or a flat rate. This article explains the concept of utility computing in detail and shares some useful best practices for 2021.

Table of Contents

What Is Utility Computing?

Utility computing is a service provisioning model that offers computing resources such as hardware, software, and network bandwidth to clients as and when they require them on an on-demand basis. The service provider charges only as per the consumption of the services, rather than a fixed charge or a flat rate.



Utility Computing

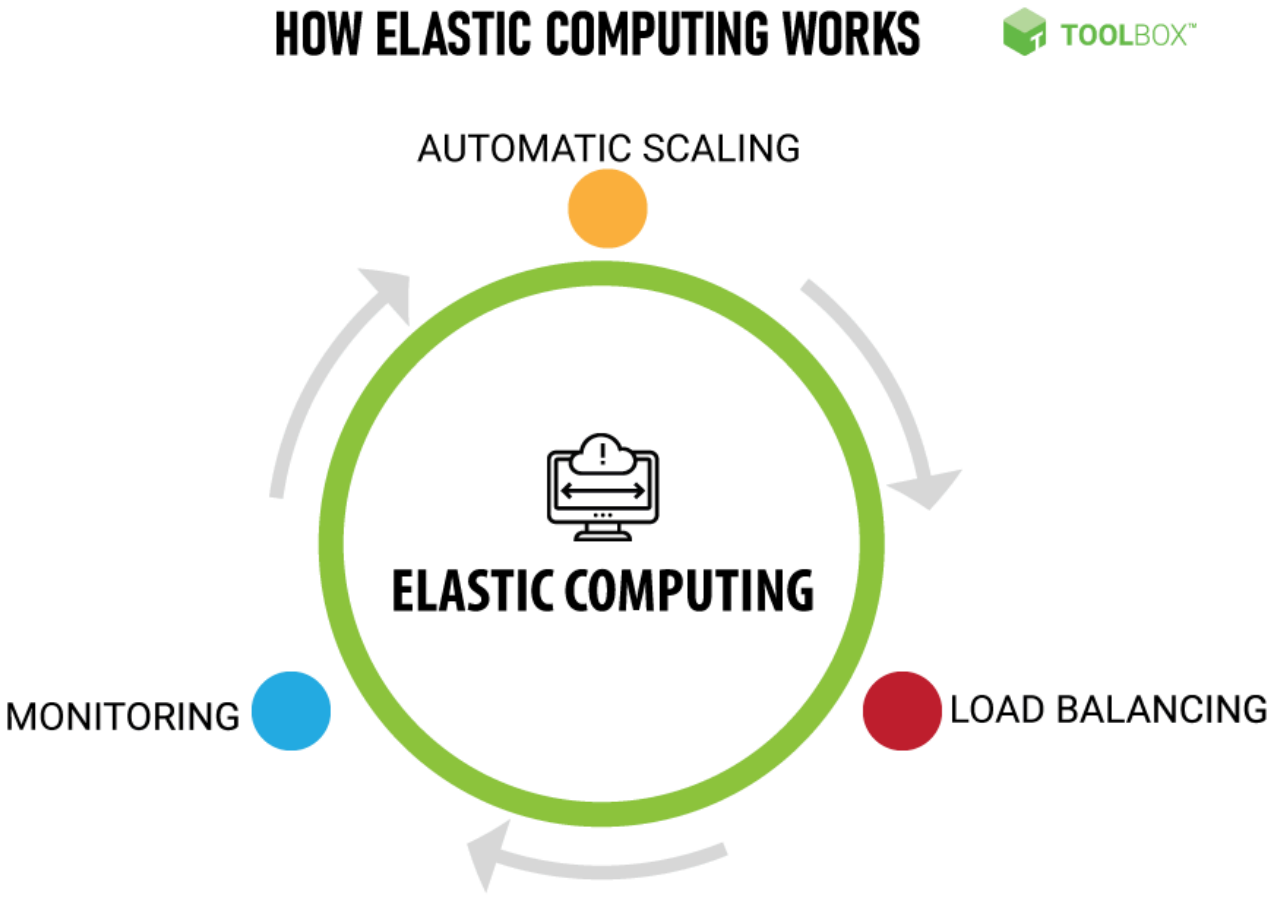
Utility computing is a subset of cloud computing, allowing users to scale up and down based on their needs. Clients, users, or businesses acquire amenities such as data storage space, computing capabilities, applications services, virtual servers, or even hardware rentals such as CPUs, monitors, and input devices.

The utility computing model is based on conventional utilities and originates from the process of making IT resources as easily available as traditional public utilities such as electricity, gas, water, and telephone services. For example, a consumer pays his electricity bill as per the number of units consumed, nothing more and nothing less. Similarly, utility computing works on the same concept, which is a pay-per-use model.

The service provider owns and manages the computing solutions and infrastructure, and the client subscribes to the same and is charged in a metered manner without any upfront cost. The concept of utility computing is simple—it provides processing power when you need it, where you need it, and at the cost of how much you use it.

What Is Elastic Computing?

Elastic computing is the ability of a cloud service provider to swiftly scale the usage of resources such as storage, infrastructure, computer processing, CPU memory, RAM, input/output bandwidth, etc., up and down to adapt to changing resource demands and dynamically meet workload requirements. Elastic computing is a part of cloud computing that entails dynamically managing the cloud server.



How Elastic Computing Works

More and more businesses recognize the benefits of elastic computing and are rapidly shifting to minimize their infrastructural costs and overcome the challenge of managing resources manually. But before we begin to unpack the concept of elasticity, it's essential to understand cloud computing first.

A prerequisite to elastic computing, cloud computing is a widely used system by IT organizations across the world today. Cloud computing allows small and large organizations to move their data to cloud storage and use various services such as online servers, software data platforms, storage space, and others over the internet.

A cloud service provider's support to quickly expand and shrink capacity at any given time provides organizations with incredible flexibility to make quick adjustments in resources without disrupting the flow of their operations.

Cloud Elasticity

Elastic computing is more efficient than a regular IT infrastructure. The system's ability to be up and running, and remain operational and responsive during unexpected fluctuations and spikes in user demand, is proof enough of its prowess. Its automated system optimizes the allocated resources and offers uninterrupted

access without breakdowns, lags, or service interruptions. It has no impact on capacity planning and engineering, even during peak usage.

Elastic computing results in overall IT cost savings, reduces dependence on human capital, and minimizes infrastructure costs. Elasticity ensures that your company doesn't end up paying for idle resources or investing in unnecessary additional resources. It balances the load by efficiently deploying the actual amount of resources required. As such, there is neither over-provisioning (allocating additional resources) nor under-provisioning (allocating lesser resources). Over-provisioning leads to higher expenditure for the service provider. On the other hand, under-provisioning results in an unpleasant service experience for customers.

Cloud Service Provider Companies

Cloud Service providers (CSP) offers various services such as **Software as a Service**, **Platform as a service**, **Infrastructure as a service**, **network services**, **business applications**, **mobile applications**, and **infrastructure** in the cloud. The cloud service providers host these services in a data center, and users can access these services through cloud provider companies using an Internet connection.

There are the following Cloud Service Providers Companies -

Amazon Web Services (AWS)

AWS (Amazon Web Services) is a **secure cloud service platform** provided by **Amazon**. It offers various services such as database storage, computing power, content delivery, Relational Database, Simple Email, Simple Queue, and other functionality to increase the organization's growth.

Features of AWS

AWS provides various powerful features for building scalable, cost-effective, enterprise applications. Some important features of AWS is given below-

- AWS is **scalable** because it has an ability to scale the computing resources up or down according to the organization's demand.
- AWS is **cost-effective** as it works on a **pay-as-you-go** pricing model.
- It provides various flexible storage options.
- It offers various **security services** such as infrastructure security, data encryption, monitoring & logging, identity & access control, penetration testing, and DDoS attacks.
- It can efficiently manage and secure Windows workloads.

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2. Microsoft Azure

Microsoft Azure is also known as **Windows Azure**. It supports various operating systems, databases, programming languages, frameworks that allow IT professionals to easily build, deploy, and manage applications through a worldwide network. It also allows users to create different groups for related utilities.

Features of Microsoft Azure

- Microsoft Azure provides **scalable**, **flexible**, and **cost-effective**
- It allows developers to quickly manage applications and websites.
- It managed each resource individually.

- Its IaaS infrastructure allows us to launch a general-purpose virtual machine in different platforms such as Windows and Linux.
- It offers a **Content Delivery System (CDS)** for delivering the Images, videos, audios, and applications.

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3. Google Cloud Platform

Google cloud platform is a product of **Google**. It consists of a set of physical devices, such as computers, hard disk drives, and virtual machines. It also helps organizations to simplify the migration process.

Features of Google Cloud

- Google cloud includes various **big data services** such as Google BigQuery, Google CloudDataproc, Google CloudDatalab, and Google Cloud Pub/Sub.
- It provides various services related to **networking**, including Google Virtual Private Cloud (VPC), Content Delivery Network, Google Cloud Load Balancing, Google Cloud Interconnect, and Google Cloud DNS.
- It offers various **scalable** and **high-performance**
- GCP provides various **serverless services** such as Messaging, Data Warehouse, Database, Compute, Storage, Data Processing, and Machine learning (ML)

- It provides a free cloud shell environment with Boost Mode.

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4. IBM Cloud Services

IBM Cloud is an open-source, faster, and more reliable platform. It is built with a suite of advanced data and AI tools. It offers various services such as Infrastructure as a service, Software as a service, and platform as a service. You can access its services like compute power, cloud data & Analytics, cloud use cases, and storage networking using internet connection.

Feature of IBM Cloud

- IBM cloud improves operational efficiency.
- Its speed and agility improve the customer's satisfaction.
- It offers Infrastructure as a Service (IaaS), Platform as a Service (PaaS), as well as Software as a Service (SaaS)
- It offers various cloud communications services to our IT environment.

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5. VMware Cloud

VMware cloud is a Software-Defined Data Center (SSDC) unified platform for the Hybrid Cloud. It allows cloud providers to build agile, flexible, efficient, and robust cloud services.

Features of VMware

- VMware cloud works on the **pay-as-per-use** model and **monthly subscription**
- It provides better customer satisfaction by protecting the user's data.
- It can easily create a new VMware **Software-Defined Data Center (SDDC)** cluster on AWS cloud by utilizing a RESTful API.
- It provides flexible storage options. We can manage our application storage on a per-application basis.
- It provides a dedicated high-performance network for managing the application traffic and also supports multicast networking.
- It eliminates the time and cost complexity.

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6. Oracle cloud

Oracle cloud platform is offered by the **Oracle Corporation**. It combines Platform as a Service, Infrastructure as a Service, Software as a Service, and Data as a Service with cloud infrastructure. It is used to perform tasks such as moving applications to the cloud, managing development environment in the cloud, and optimize connection performance.

Features of Oracle cloud

- Oracle cloud provides various tools for build, integrate, monitor, and secure the applications.
- Its infrastructure uses various languages including, Java, Ruby, PHP, Node.js.
- It integrates with Docker, VMware, and other DevOps tools.
- Oracle database not only provides unparalleled integration between IaaS, PaaS, and SaaS, but also integrates with the on-premises platform to improve operational efficiency.
- It maximizes the value of IT investments.
- It offers customizable Virtual Cloud Networks, firewalls, and IP addresses to securely support private networks.

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7. Red Hat

Red Hat virtualization is an open standard and desktop virtualization platform produced by Red Hat. It is very popular for the Linux environment to provide various infrastructure solutions for virtualized servers as well as technical workstations. Most of the small and medium-sized organizations use Red Hat to run their organizations smoothly. It offers higher density, better performance, agility, and security to the resources. It also improves the organization's economy by providing cheaper and easier management capabilities.

Features of Rad Hat

- Red Hat provides secure, certified, and updated container images via the Red Hat Container catalog.
- Red Hat cloud includes **OpenShift,** which is an app development platform that allows developers to **access**, **modernize**, and **deploy apps**
- It supports up to 16 virtual machines, each having up to 256GB of RAM.
- It offers better reliability, availability, and serviceability.
- It provides flexible storage capabilities, including very large SAN-based storage, better management of memory allocations, high availability of LVMs, and support for particularly roll-back.
- In the Desktop environment, it includes features like New on-screen keyboard, GNOME software, which allows us to install applications, update application, as well as extended device support.

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8. DigitalOcean

DigitalOcean is the unique cloud provider that offers computing services to the organization. It was founded in 2011 by Moisey Uretsky and Ben. It is one of the best cloud provider that allows us to manage and deploy web applications.

Features of DigitalOcean

- It uses the KVM hypervisor to allocate physical resources to the virtual servers.
- It provides high-quality performance.
- It offers a digital community platform that helps to answer queries and holding feedbacks.
- It allows developers to use cloud servers to quickly create new virtual machines for their projects.
- It offers one-click apps for droplets. These apps include MySQL, Docker, MongoDB, Wordpress, PhpMyAdmin, LAMP stack, Ghost, and Machine Learning.

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9. Rackspace

Rackspace offers cloud computing services such as hosting web applications, Cloud Backup, Cloud Block Storage, Databases, and Cloud Servers. The main aim to designing Rackspace is to easily manage private and public cloud deployments. Its data centers operating in the USA, UK, Hong Kong, and Australia.

Features of Rackspace

- Rackspace provides various tools that help organizations to collaborate and communicate more efficiently.
- We can access files that are stored on the Rackspace cloud drive, anywhere, anytime using any device.
- It offers 6 globally data centers.
- It can manage both virtual servers and dedicated physical servers on the same network.
- It provides better performance at a lower cost.

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10. Alibaba Cloud

Alibaba Cloud is used to develop data management and highly scalable cloud computing services. It offers various services, including Elastic Computing, Storage, Networking, Security, Database Services, Application Services, Media Services, Cloud Communication, and Internet of Things.

Features of Alibaba Cloud

- Alibaba cloud offers a suite of global cloud computing services for both international customers and Alibaba Group's e-commerce ecosystem.
- Its services are available on a pay-as-per-use basis.
- It globally deals with its 14 data centers.
- It offers scalable and reliable data storage.