**Introduction**

The cloud computing system is composed of a set of layers upon which distributed applications are built. These layers include ***infrastructure, platform,*** **and** ***software*****.** Based on these three layers, we can devise three cloud computing models are devised.

1. **Infrastructure as a Service (IaaS)** model provides **infrastructure-related services** and is responsible for handling **hardware-related issues, power, and cool management** in data centers.
2. **Platform as a Service (PaaS)** model takes the **responsibilities of operating system, database management, server, and programming language**.
3. **Software as a Service (SaaS)** model handles **software-related issue**s and provides amenities to the cloud users.

## 1. CLOUD SERVICE MODELS

On the basis of allocation of resources, cloud computing offers their services.

**1. Bottom layer (layer-1)—**IaaS—accommodates memory, CPU, and additional hardware resources

**2. Middle layer (layer-2)—**PaaS—accommodates diverse settings for consumer-particular services

3. **Top layer (layer-3)—**SaaS—cloud service accessing occurs via web browsers and web services

| | |
|---|---|
| **SaaS**<br>Email, virtual desktop, games, etc. | Layer-3 |
| **PaaS**<br>Database, web server, development tools, etc. | Layer-2 |
| **IaaS**<br>Servers, storage, virtual machines, network, etc. | Layer-1 |

**Software as a Service:**

- **Software as a Service (SaaS)** is a software distribution model in which applications are hosted by a vendor or service provider and made available to customers over the Internet.
- **National Institute of Standards and Technologies (NIST) defines cloud SaaS as follows:**

"*The capability provided to the consumer is to use the provider's applications running on a cloud infrastructure. The applications are accessible from various client devices through either a thin client interface, such as a web browser (e.g., web-based email), or a program interface. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, or even individual application capabilities, with the possible exception of limited user-specific application configuration settings".*



**Some of the applications of SaaS are:**

- Complaint resolution system
- Employee management system
- Attendance resolutions system
- E-police, E-court
- Municipal maintenance
- Water board, billing, payment systems
- District management solutions
- Service desk

SaaS presents opportunities for software vendors, which are;

- Augmented operation speed
- Improved adoption user
- Reduction of secondary requirements
- Reduction implementation upgradation cost software

The client makes request for a service to the server and the server in turn provides the service to client 4.2. As cloud technology, the cloud client makes a request to the cloud server and the cloud server provides the service requested by the client. This has been shown in fig 4.3.

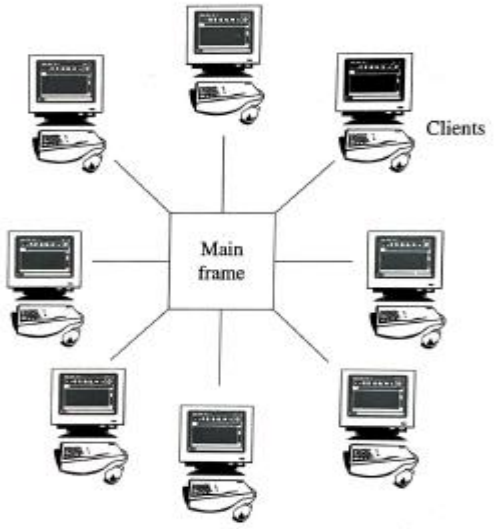



Fig. 4.2 Client–Server technology

The size SaaS infrastructure large contrast to that of client-server technology and in the number customers whom it should be capable serving. Figure 4.3 shows relationship of a client to the cloud in SaaS. The cloud consists of various diverse computer resources and tools to operate various software and applications needed by customers. Many clients can simultaneously operate services provided by various cloud service providers. SaaS software is easily accessible cloud users. Cloud users have to pay very cost for these facilities. Figure 4.4 shows SaaS provided cloud computing.



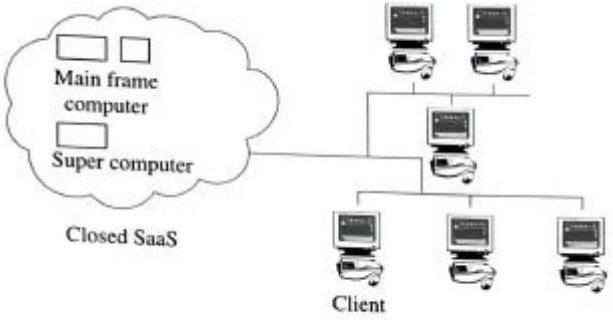
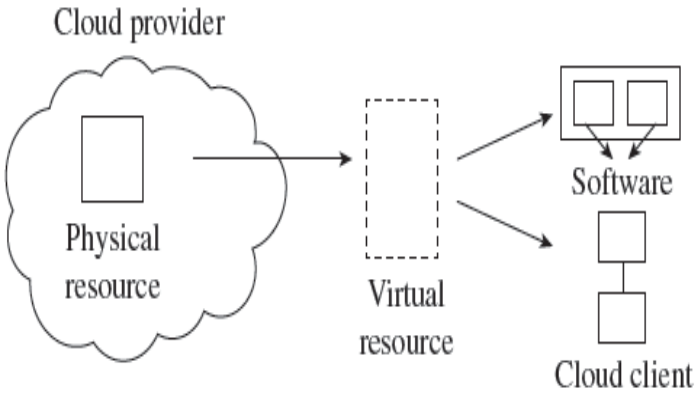



Fig. 4.3 Cloud technology




***Importance of SaaS***

The advantage of the SaaS model is that the applications serve a wide range of users and these can be adapted to specific needs with little customization. SaaS is a one-to-many software delivery model, where an application is shared across multiple users. The following are some of the reasons SaaS services are required:

1. Straightforward expenses are nil.
2. You only need a web browser to access the application. It doesn't require other hardware purchase or software installation.
3. It provides quick operation service.
4. SaaS is extremely scalable.
5. Since the source code is the same for each customer, it is a multi-tenant design that makes it extremely proficient.
6. SaaS can endure every demand, because of easy arrangement; this is usually not simple with conventional applications.
7. Any noble technical modernization is effortlessly incorporated by the supplier that is accessible to all subscribers because, usually, all the consumers use a similar code base.



In the conventional model, the consumer has many concerns. Some of these include the following:

- Compatibility with hardware, additional software, and operating systems
- Licensing and compliance issues

***Uniqueness in SaaS***

Software as a Service model is unique because:

1. Its applications do not require complicated steering and are simple to use.
2. Its applications are service-oriented and modular.
3. The product sold to the customer is application access.
4. SaaS applications have an integrated invoicing service.
5. The applications are centrally managed.
6. Its applications ensure that the data of every consumer is saved and protected.
7. Its applications require offering complicated business procedure arrangements for consumers.
8. Its applications are required to continually offer swift releases of noble potential and traits.

***Various Providers of SaaS***

- NetSuite
- Intuit
- Intacct
- Financial Force.com
- Coupa Software
- AT&T

**Platform as a Service**

Platform in computer software is nothing but the computing platform, which means certain hardware architecture, an operating system (OS), and runtime libraries. Altogether, it can be said to be the stage on which computer programs can run. The Platform as a Service (PaaS) model makes all of the facilities required to support the complete life cycle of building and delivering web applications and services available from the Internet. Cloud computing has evolved to include platforms for building and running web-based applications, a concept known as PaaS. Cloud suppliers, in the PaaS model, carry a computing platform characteristically comprising a database, operating system, web server and programming language implementation, as shown in Fig. 4.5.

National Institute of Standards and Technologies (NIST) defines cloud PaaS as follows:

*The capability provided to the consumer is to deploy onto the cloud infrastructure consumer-created or acquired applications created using programming languages, libraries, services, and tools supported by the provider. The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage, but has control over the deployed applications and possibly configuration settings for the application-hosting environment.*



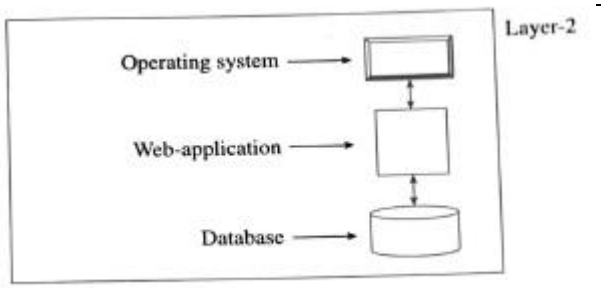



Fig. 4.5 Platform as a Service

Examples of PaaS include Heroku, Amazon Elastic Beanstalk, Google App Engine, Microsoft Azure Mendix, and Engine Yard.

A number of standard platforms they offer are as follows:

1. Multiple operating system support
2. Platform for accessing database
3. Act as middleware

The following has to be performed in the PaaS:

- Attain and install the server.
- Organize the operating system, operate time settings, and source manage depository and other middleware to work efficiently.
- Organize the operating system, operating time settings, warehouse, and supplementary middleware
- Copy data for further reference.
- The best way to comprehend PaaS is to split it separately into its major constituents—service and platform.

**Uniqueness in PaaS**

Platform as a Service has unique features which make it different from other services provided by the cloud providers, such as the following:

**Application expansion structure:** A vital application expansion structure developed on technology extensively used. The cloud user can customize the application as per the requirement.

**Simplicity of use:** PaaS uses a user-friendly approach. Devices which have drag-and-drop options support several average integrated development environments (IDEs) are available. It helps to quicken application development.

**Accessibility:** An alternative platform is reachable and available anywhere, anytime.

**Scalability:** The platform is adequately elegant to control the flexible ability of a fundamental infrastructure to manage application loads.

**Safety**: The platform deals with items such as SQL operation, cross-site drafting, traffic encryption and service rejection and formulates it into intrinsic application advancements.

**Comprehensiveness:** The platform offers the facility to comprise, insert, and incorporate other applications set up on similar platforms.



**Portability:** The platforms are compatible with the fundamental infrastructure and permit corporations to shift the application from one laaS to another.

**Porting devices**: These are used to assist in effortless and swift data migration from on-premise applications to other applications.

**Properly documented:** The platform has a properly-documented API to carry out assignments such as user verification, saving of files, and occasionally even making straightforward calls to data base. This will permit your company to have the flexibility of customizing and generating software application to interface with the platform which meets the particular requirements of company.

**Google App Engine**

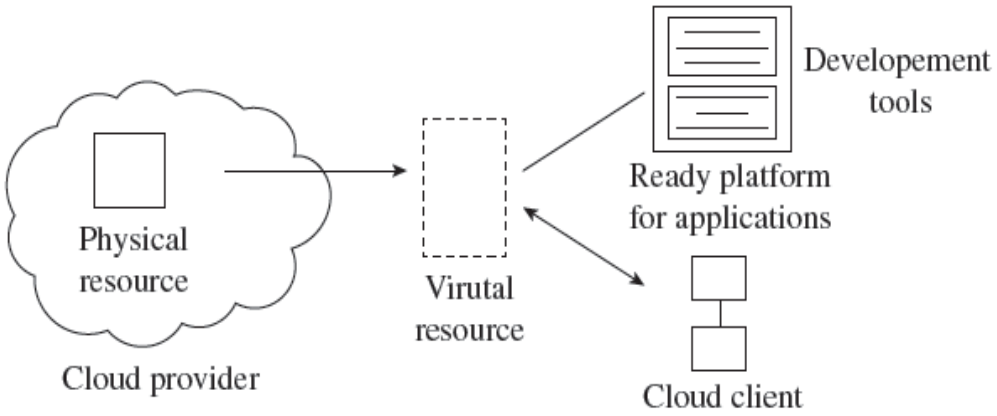
Google App Engine users to build and run applications on Google's infrastructure. These applications are very easy create and maintain with the facility of scaling up and down. You need not worry about maintaining the complexity of servers: only need to upload your application and move further. Google App Engine is platform for providing users various built-in services and API. You can build your own web applications and mobile tools: As per traffic, it automatically handles applications and you need not pay more for services you have not used. You are free to upload your code; the rest is managed by Google. Other tools and built-in services are also available, such as load balancing and application logging for users. Google App Engine also automatically offers instant scaling feature to your application. Security features are also associated with your web application that is provided Google App Engine free of cost.

Using Google App (First Application) to make application
You create simple application using the "+" option already provided
1. First of you have to make folder, for example, Myapp, then make a subfolder with in it
2. By using text editor, you can make your file and into the subfolder with a .yaml extension.
3. Make another file with a .py extension and save it in the same folder
4. Move ahead by starting Google AppEngineLauncher given in application
5. GO to file and select AddExisting Application and locate the folder and subfolder have created. After selecting your application, Click Run.
6. The application will start soon and you get an icon to move ahead
7. After pressing Browse you get your application at http://localhost
8. You can edit and make changes in your application with the given tools
9. For shutting down the server, select your application and click the stop button

**PaaS Selected as per Requirement**

For cloud telephony service, KooKoo PaaS has been proposed by India-based Ozonetel Systems Figure 4.6 shows Platform as a Service provided by cloud computing. Physical resources are made available to cloud clients by using various virtualization tools. Virtual resource of PaaS provides development tools, ready platform for various applications, etc., to cloud users.






**Features of PaaS for Application Developers**

The following are the important features of PaaS for application developers.

1. A virtual development environment
2. Application principles generally based on the developers' necessities
3. An interface with tools 'virtual development"
4. A ready-to-use tool for public application developers

**Various service providers of PaaS:**

- Terremark
- Engine Yard
- AT & T
- Atlassian
- PivotalLab
- AppScale
- Engine Yard
- Flexiscale

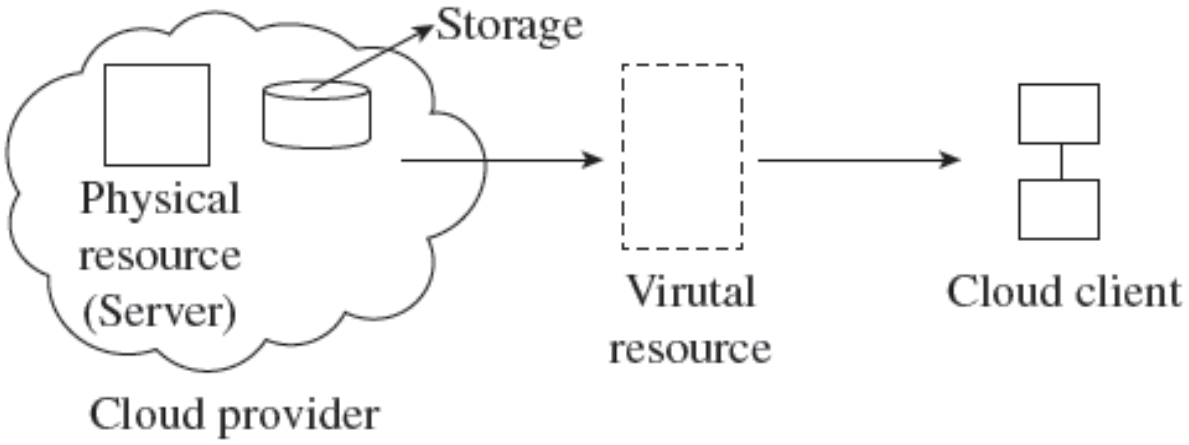
**Infrastructure as a Service**

Infrastructure as a Service (IaaS) is the delivery of computer infrastructure as a service. In this most fundamental cloud service model, cloud suppliers propose computers, as physical or more frequently as virtual machines, and further resources. The virtual machines operate as visitors by a hypervisor, such as KVM or Xen.

To install the applications, cloud users subsequently deploy operating system images on their application software and the machines as well. In this situation, the cloud user is liable for sustaining and patching the application software and operating systems. Cloud suppliers characteristically invoice IaaS services on the basis of utility computing, that is, pay only for the amount of resources allotted and utilized, as shown in Fig. 4.7 in which cloud providers have various resources offered to the user and the virtual instance of all resources is available.

IaaS refers not only to a machine which performs the entire work, but also to an ability specified to companies which offers users the control of additional storage space in data centers and servers. Examples of IaaS include Rackspace Cloud, RightScale, Amazon CloudFormation (fundamental services like Amazon EC2), and Google Compute Engine.






National Institute of Standards and Technologies (NIST) defines cloud IaaS as follows:

> "*The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources where the consumer is able to deploy and run arbitrary software, which can include operating systems and applications. The consumer does not manage or control the underlying cloud infrastructure but has control over operating systems, storage, and deployed applications; and possibly limited control of select networking components (e.g., host firewalls)".*

Machine Virtualization: The relationship between hypervisor, VMs, and computer has been shown in Fig. 4.8. Various virtual machines are supported by the hypervisor for providing services to many users. It is easy to recognize IaaS, as it is usually platform-free. It consists of an amalgamation of software and hardware resources. IaaS software is a low-stage code which runs independent of an operating system known as a hypervisor and is responsible for keeping record of hardware resources and distributing those resources on the basis of order. This process is termed as resource pooling.

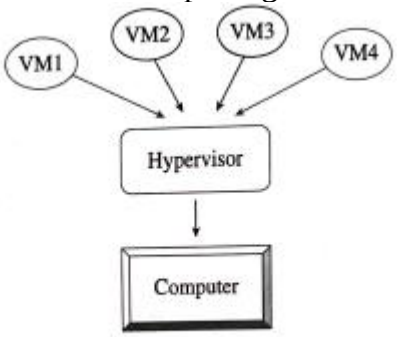



**Fig. 4.8** Relationship among VMs, hypervisor, and computer

A hypervisor, also known as virtual machine manager (VMM), is one among the several hardware virtualization practices which authorizes various operating systems, labelled guests. in order to work concurrently on the computer of a host. With IaaS, you have the ability to use networks, storage, and further computing resources, where you may install and operate subjective software such as applications and operating systems.



***Various Service Providers of IaaS***

Amazon is the pioneer of IaaS. In India, IaaS providers include NetMagicSolutions and InstaCompute (from Tata Communications). The other leading providers are:

- Rackspace
- Joyent
- Rightscale
- Terremark
- GoGrid
- Elastic Hosts
- Symetriq

**Benefits of Service Models**

The cloud computing service model offers a variety of advantages, which are listed here:

1. Global accessibility
2. Automated update and patch management services
3. Seamless integration
4. Scale easily
5. Maximize uptime
6. High availability
7. Cost saving
8. Flexibility

**Cluster as a Service:** Commodity servers clusters are used for various distributed applications such as data analysis, simulation, web services, etc . Not one particular framework can fit every distributed application, not even the Openstack cloud framework. For example, some researchers desire to install hadoop clusters on bear metal servers. To this problem, one solution is to assign a layer below the IaaS/PaaS layer with the job of handling cluster deployment. This idea is known as the Cluster as a Service (CaaS) layer for allocating servers.

***Design issue Needs***

Design requirements for CaaS are:

- For every cluster, dynamic resource allocation is required
- It is important to secure isolation among clusters
- Sufficient capacity and performance for every cluster

***Design Description***

- Between IaaS/PaaS layer and CaaS layer, there is a separation
- Efficiently handling of CaaS layer machine images using containers
- CaaS layer is a web service
- Isolation of Network through tagged VLAN
- Automatic package installation



## 2. CLOUD COMPUTING SUB SERVICE MODELS

Apart from the three main service models of cloud computing, the following are some of the sub-service models, which are also providing services to cloud users.

**Everything as a Service**

Everything as a Service (XaaS) cloud computing provides various services to users on the basis of user demand. XaaS in cloud computing is a term that is used for the wide variety of services and applications emerging for users to access on demand over the Internet.

XaaS supports various services such as SaaS, IaaS, desktop as a service, disaster recovery as a service, marketing as a service, and many others. It provides facilities and flexibility to users for customizing the computing environments as per requirements.

**Compliance as a Service**

Compliance as a Service offers compliance collection and facilitates your cloud applications as per corporate policies or organization requirements. Issues of cloud compliance occur when you make use of cloud storage or any type of backup services. Customer data is moving from internal storage to the cloud environment so it is the vital responsibility of the cloud provider to maintain a service-level agreement for compliance. Customers are always concerned about cloud security—what information should be put on a public cloud and what on a private cloud. Security of cloud and cloud compliance is actually responsibility of both the cloud vendor and cloud customers. Certificates for security compliances provided by cloud vendors (e.g., azure, amazon, etc.).

**Identity as a Service**

Identity as a Service (IdaaS) refers to identity services by cloud service providers for providing on-site or off-site services to customers. Services may include directory management, or the operation of a single sign-on service (SSO). IdaaS is actually an authentication infrastructure that IdaaS refers to identity services by cloud service provider for providing on-site or off-site services to customers.

In IaaS development and implementation, there are a number of challenges. Security depends on the type of identity.

- SaaS—Customers using IdaaS with SaaS get services on the basis of types of user, such as internal users, external users, or others.
- PaaS—Customers using IdaaS with PaaS handle issues regarding web service.
- IaaS—Management of privileged access to virtual machines is handled in IdaaS with IaaS.

**IaaS: DataBase as a Service (DBaaS):** DBaaS permits the access and utilization of a database administration system as a service.

**Paas: Storage as a Service (STaaS)**

It is accountable for the transfer of data storage as a service, comprising database services, often owed on a utility computing base.

**SaaS: Communications as a Service (CaaS)**

It offers a business relations' resolution, such as video conferencing, instant messaging, voice over Internet protocol (VOIP), and many more.

**SaaS: Security as a Service (SECaaS)**

It offers the safety of corporation networks and mobile networks via the Internet for different dealings, databases, applications, events, and system proceedings.



**SaaS: Monitoring as a Service (MaaS)**

It offers services for the transfer of second-level infrastructure such as asset tracking, log management as a service, etc.

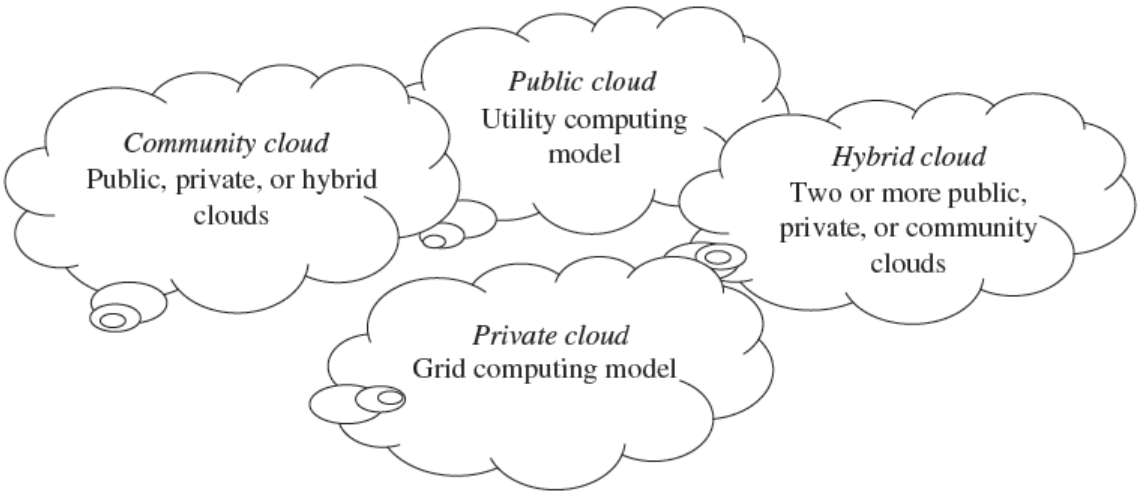
**PaaS: Desktop as a Service (DTaaS)**

It is a service or platform provided by the cloud provider by which back end of the virtual desktop infrastructure is hosted.

**IaaS: Compute Capacity as a Service (CCaaS)**

CCaaS is the condition of 'unprocessed' computing resources, characteristically used in the implementation of mathematically versatile models from either a 'supercomputer resource or a great number of distributed computing resources anywhere that the assignment is carried out correctly.

## 3. CLOUD DEPLOYMENT MODELS




The cloud model is invented with four deployment models —public cloud, private cloud, hybrid cloud and community cloud. As per NIST, the following are the deployment models:

*Private cloud:* Cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or a combination of them. It may exist on or off premises.

*Community cloud:* The cloud infrastructure is provisioned for exclusive use by a specific community of consumers from organizations that have shared concerns (e.g., mission, security requirements, policy, and compliance considerations). It may be owned, managed, and operated by one or more of the organizations in the community, a third party, or a combination of them. It may exist on or off premises.

*Public cloud:* The cloud infrastructure is provisioned for open use by the general public. It may be owned, managed, and operated by a business, academic, or government organization, or some combination of them. It exists on the premises of the cloud provider.

*Hybrid cloud :* The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or




proprietary technologies that enable data and application portability (e.g., cloud bursting for load balancing between clouds).

**Public Clouds:** The public cloud is the first deployment model (Fig. 4.10). In this model, users have many options to opt for and *decide* on any service provider as per requirement. 'Public does not constantly indicate it is free; it may cost a smaller amount or satisfactorily be used at a lesser rate. This model offers a cost effective way to establish cloud services. The physical infrastructure of the public cloud is possessed by a cloud service supplier. This cloud operates applications from distinct consumers who share this infrastructure and pay for their resource consumption on a utility computing base.

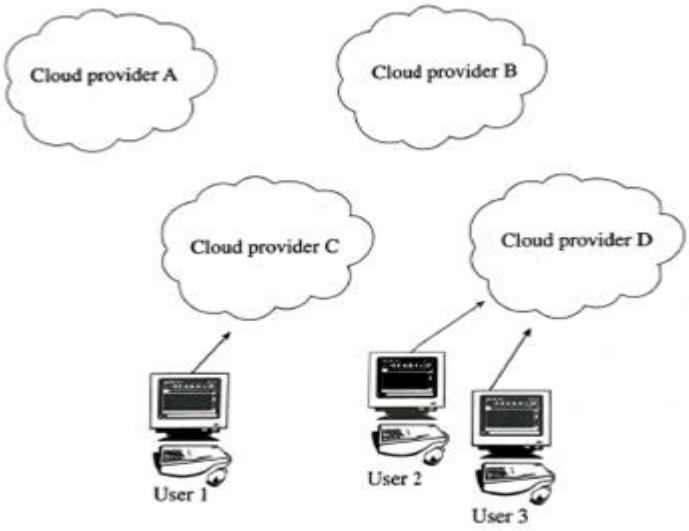



Fig. 4.10 Public cloud computing

In a public cloud, computing resources are available for all. No initial investment is required for availing any services from the cloud. Examples of public cloud vendors include Google, Amazon Elastic Compute Cloud, Windows Azure Services Platform, Microsoft, etc.

This model is best matched for company necessities in which it is needed to administer load run through host SaaS applications, consume provisional infrastructure for rising and experimenting applications, and administer applications which are utilized by various users that would need high investment in infrastructure from companies. This model assists in the reduction of capital expenses and removes equipped IT expenses. Figure 4.11 shows the working of cloud providers. Different clients can easily access collection of services provided by cloud providers.




Fig. 4.11 Working of cloud providers

***Public Cloud—Azure***

Azure has a wide range of operating systems, various programming languages, frameworks, tools, databases, etc. It supports to build apps with JavaScript, Python, .NET, Java, etc. It also provides support to make back-ends for Android.

Azure has an efficient IT environment with the largest network of secure private network, databases, and storage with various security features. Azure supports flexibility of user demands by providing a scale up or down feature and accordingly pay-as-you-go service is supported. Billing is done on a per-minute basis and provides users with infrastructure services such as compute, storage, and bandwidth with very good performance. Azure has a large network at the data center across several countries.

To the common community, public cloud storage, applications, and additional resources are made accessible by a service supplier. These services are free or proposed on a pay-per-use model. Usually, public cloud service suppliers such as Google, Microsoft, and Amazon AWS take possession of and run the infrastructure, and propose access via the Internet

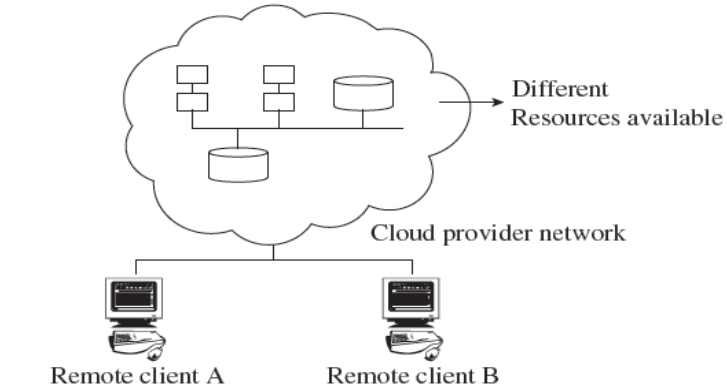
**Private Clouds**

The private cloud is the second deployment model. The private cloud offers several advantages of an open cloud computing setting that comprises its service support and flexibility. The difference comprising a private cloud and a public cloud is perceived in several services or applications proposed by a private cloud service. The growth and information are managed inside the cluster without the restrictions of the system bandwidth, authorized requirements, and security procedures disclosure, Private cloud is displayed in Fig. 4.12. Furthermore, private cloud services offer the user control over cloud infrastructure.

Private clouds allow infrastructure to be accessed only by the members of the organization and granted by third parties. Private cloud is hosted in the data center of the company and offers services only to users within the company. The major drawback with a private cloud is higher cost as compared to a public cloud. Examples of private



cloud include Eucalyptus cloud computing infrastructure with Ubuntu Server, Elastra private-cloud, Vmware, Microsoft, etc.




*"The cloud infrastructure is provisioned for exclusive use by a single organization comprising multiple consumers (e.g., business units). It may be owned, managed, and operated by the organization, a third party, or some combination of them, and it may exist on or off premises"*

**Community Clouds**

Community Cloud is the third model. The community cloud is limited and consumed by means of a group or cluster which includes universal significances and reason, such as a general task. The associates of the society assign contact to the application and information on the cloud. This variety will possibly provide a better power of protection and segregation.

A community cloud falls between public and private clouds category. The drawback related to a community cloud is that of having costs higher than a public cloud. Examples of community cloud include Google's 'Gov Cloud', NASA Nebula cloud, etc.

***Community Cloud—OpenNebula***

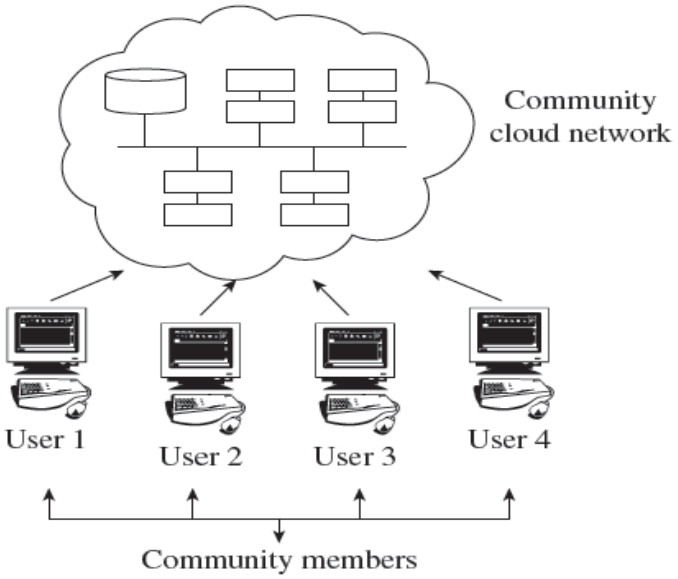
OpenNebula is a cloud computing tool for running various distributed data center infrastructures. The OpenNebula tool controls a virtual infrastructure of the data center to construct hybrid, public, and private executions of infrastructure as a service. OpenNebula is free and open-source software, put through the necessities of the Apache Licence edition 2. It coordinates network, storage, virtualization, security, and scrutinizing technologies to install multi-layer services as virtual machines on distributed infrastructures, merging both isolated resources and data center cloud resources, as per allotment strategies.

The tool includes characteristics for administration, amalgamation, scalability, accounting, and safety. It also declares consistency, portability, and interoperability, offering managers and cloud users with a number of cloud interfaces (e.g., vCloud, OGF Open Cloud Computing Interface, Amazon EC2 Que$_{ry}$) and hypervisors (e.g., VMware, KVM, and Xen) and may put up manifold software and hardware amalgamations in a data center. Community cloud is displayed in Fig. 4.13.



*Corporations that share the cloud infrastructure support a particular community which has shared apprehensions (e.g., safety necessities, assignment, and acquiescence and strategy consideration). It can be controlled by the corporations or a third party and might exist off_ premise or on-premise.*

In the community deployment model, numerous corporations share the cloud infrastructure with similar strategy and agreement consideration. This assists in the reduction of expenses (in contrast to a private cloud), since it is shared by a bigger group or cluster




## Hybrid Clouds

- The hybrid cloud is a combination of a private and public cloud which is mutually dependent on one another.
- In this model, cloud users are supplied with information on the public cloud, in spite of the reality that the cloud supplier has to maintain the company-significant services and information in a few instructions.

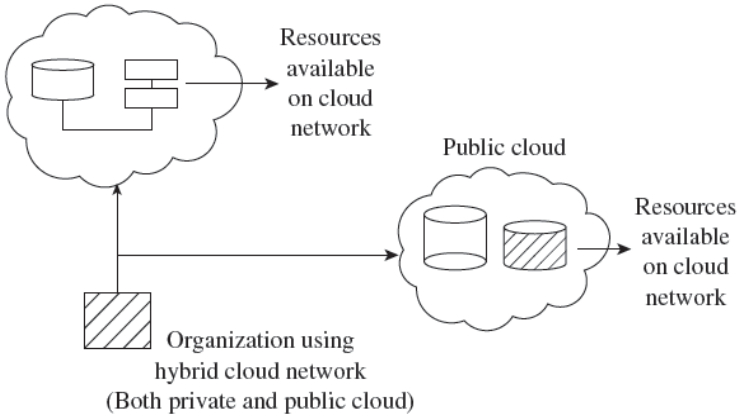
Hybrid cloud is a constitution of two or more clouds (i.e., community. public, or private) which exceptional units but are bound mutually, providing the advantages of various deployment models. By means of employing hybrid cloud' design, individuals and corporations are capable of acquiring levels of error tolerance combined with regionally instant usability. Hybrid cloud design needs both OR-premise resources and off-place (isolated) server-based cloud infrastructure. Hybrid cloud is shown in Fig' 4.14.

Hybrid cloud offers the flexibility of internal applications along with the scalability and error tolerance of cloud-based services. A hybrid cloud is a combination of the public, private, and community cloud. It is defined by NIST as follows:

*"The cloud infrastructure is a composition of two or more distinct cloud infrastructures (private, community, or public) that remain unique entities, but are bound together by standardized or*



*proprietary technology that enables data and application portability (e.g., cloud bursting for load balancing between clouds)"*




An illustration of hybrid cloud deployment might consist of a corporation installing non-critical software applications within the public cloud, whereas holding perceptive or significant applications in a private cloud, on the location.

One characteristic of hybrid clouds which makes them distinguishable from the other kinds of cloud deployment is 'cloudburst'. Most general hybrid clouds are an amalgamation of both public and private cloud computing settings that are installed, employed, and perform constantly.

## 4. ALTERNATIVE DEPLOYMENT MODELS

A completely dissimilar outlook of the cloud computing design is within the Jericho cloud cube model and the Linthicum model.

**Linthicum Model**

There are 10 main classes or designs on the basis of the model:

**Storage as a Service:** The capability to influence storage which physically exists at a different location, but is logically a local storage resource to every application which needs storage.

**Database as a Service:** The capability influence a distantly hosted database service, sharing it with other users, and keeping it local to act as if the database were local.

**Information as a Service:** The capability to utilize any kind of information, distantly hosted, via a definite interface like an APL

**Process as a Service**: An isolated resource which is capable of connecting various resources collectively, either hosted inside the similar cloud computing resource or isolated, to generate business procedures.

**Application as a Service:** Any application conveyed over the web platform to an end user, characteristically controlling the application via a browser.

**Platform as a Service:** An absolute platform, comprising interface improvement, application expansion, investigation, database expansion, and storage, conveyed via a distantly hosted platform to subscribers



**Integration as a Service:** The capability to transport a whole amalgamation load from the cloud, together with interfacing with applications, flow control, semantic negotiation, and amalgamation intend.

**Security as a Service:** The capability to carry principal safety services distantly over the Internet.

**Management as a Service:** Any on-command service which offers the capability to control one or more cloud services, characteristically uncomplicated things such as topology, resource consumption, virtualization, and uptime administration.

**Testing as a Service:** The capability to analyse regional or cloud-carried systems by using testing services and software which are distantly hosted.

Jericho Cloud Cube Model

The objective of the Cloud Cube Model is to:

1. Indicate that not all that is executed in the clouds is good; it might be best to run some corporation tasks by using a conventional non-cloud approach.

2 Describe the diverse cloud configurations which have been identified by the Jericho Forum.

3. Explain chief aspects, threats, and advantages of every cloud configuration.

4. Offer a structure for discovering in further detail the character of various cloud configurations and the matters which require building them securely and to protect the areas to work in.

The model for cloud computing is explained by the Jericho Cloud Cube Model as encompassing four "dimensions:

**Internal or external:** This describes the physical position of the data. If it is inside your individual physical periphery, in-house, or exterior, which means it is not inside your individual physical periphery.

**Proprietary or open:** Proprietary denotes that the corporation offering the service is holding the resources of condition under their possession, Open clouds are using technology which is not proprietary.

**Perimeterized or de-perimeterized architectures:** Within your conventional IT perimeter, de-perimeterization hus forever been associated with the fixed removal, breakdown, or decrease of the conventional IT perimeter.

**Outsourced or insourced: Outsourced** means the service is offered by a third party, whereas insourced is the service offered by personal employees under your power.

## 5. CLOUDSTACK

CloudStack is cloud software which assists users to alter the cloud according to their requirements. It is an open-source platform for developing hybrid, public, and private infrastructure as service clouds. It controls and supports the network, storage, and compute joints in a cloud infrastructure. It is used to arrange, control, and systematize situations in cloud computing. CloudStack is used to generate flexible cloud services. It i tis, in fact, an Infrastructure as a Service which carries some infrastructure or associated technique for service hosting for the developer. This is specifically why cloud stack is known as "do it



yourself". It supports various hypervisors along with manifold hardware into an only virtual access.

With CloudStack, you are capable of the following:

1. Establishing an on-command, flexible cloud computing service. Service suppliers may offer self-service virtual machines, networking arrangements, and storage sizes over the Internet.
2. CloudStack may be used to construct an on-command cloud computing service along with flexibility, Service supplier provides storage and virtual machines, and much more on the Internet
3. An organization or worker could establish an on-premise private cloud along with CloudStack

## 6. CLOUD STORAGE

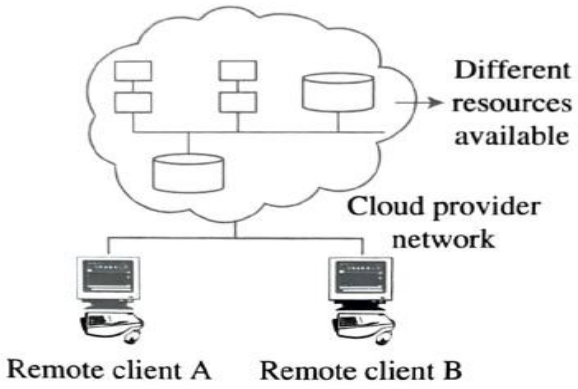



**Fig. 4.15** Remote services provided to cloud consumer

Cloud storage is a service model wherein data is maintained, controlled, and backed up distantly and made accessible to users over a network (characteristically the Internet). Figure 4.15 explains the remote services provided to the cloud consumer. There are three major cloud storage models which are as follows:

1. Public cloud storage services, like Amazon's Simple Storage Service (S3), offers a multi-occupant storage appropriate for data.
2. Private cloud storage services offer a dedicated storage restricted behind the firewall of a corporation Private clouds are suitable for users who require customization and more power on their data.
3. Hybrid cloud storage is an amalgamation of the other two models, which comprise no less than a single public cloud and a single private cloud infrastructure. A corporation could, for instance, collect forcefully used and prepared data on a private cloud and sharable data on a public cloud.

Cloud storage is a module of networked online storage in which data is saved in virtualized groups of storage that are normally hosted by third parties. Cloud storage services can be accessed via a web service application programming interface (API), or via a web-based user interface.