Cloud Deployment Model

- Public Cloud
- Private Cloud
- Hybrid Cloud
- Community Cloud

3.3.1 Public cloud

- A public cloud is one in which the cloud infrastructure and computing resources are made available to the general public over a public network.
- A public cloud is meant to serve a multitude(huge number) of users, not a single customer.
- A fundamental characteristic of public clouds is multitenancy.
- Multitenancy allows multiple users to work in a software environment at the same time, each with their own resources.
- Built over the Internet (i.e., service provider offers resources, applications storage to the customers over the internet) and can be accessed by any user.
- Owned by service providers and are accessible through a subscription.
- Best Option for small enterprises, which are able to start their businesses without large up-front(initial) investment.
- By renting the services, customers were able to dynamically upsize or downsize their IT according to the demands of their business.
- Services are offered on a price-per-use basis.
- Promotes standardization, preserve capital investment
- Public clouds have geographically dispersed datacenters to share the load of users and better serve them according to their locations
- Provider is in control of the infrastructure

Examples:

o Amazon EC2 is a public cloud that provides Infrastructure as a Service

o Google AppEngine is a public cloud that provides Platform as a Service

o SalesForce.com is a public cloud that provides software as a service.

Advantage

- **Offers unlimited scalability** – on demand resources are available to meet your business needs.
- **Lower costs**—no need to purchase hardware or software and you pay only for the service you use.

- **No maintenance -** Service provider provides the maintenance.
- **Offers reliability:** Vast number of resources are available so failure of a system will not interrupt service.
- Services like SaaS, PaaS, IaaS are easily available on Public Cloud platform as it can be accessed from anywhere through any Internet enabled devices.
- **Location independent** – the services can be accessed from any location

Disadvantage

- No control over privacy or security
- Cannot be used for use of sensitive applications(Government and Military agencies will not consider Public cloud)
- Lacks complete flexibility(since dependent on provider)
- No stringent (strict) protocols regarding data management

3.3.2 Private Cloud

- Cloud services are used by a single organization, which are not exposed to the public
- Services are always maintained on a private network and the hardware and software are dedicated only to single organization
- Private cloud is physically located at
    - Organization's premises [On-site private clouds] **(or)**
    - Outsourced(Given) to a third party[Outsource private Clouds]
- It may be managed either by
- Cloud Consumer organization (or)
    - By a third party
- Private clouds are used by
    - government agencies
    - financial institutions
    - Mid size to large-size organisations.
- On-site private clouds

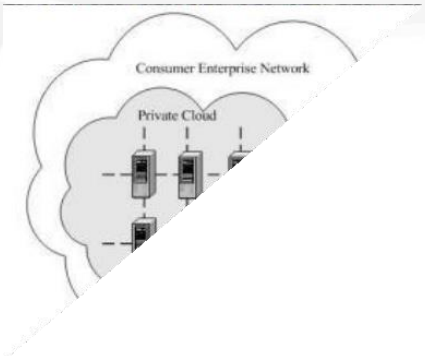
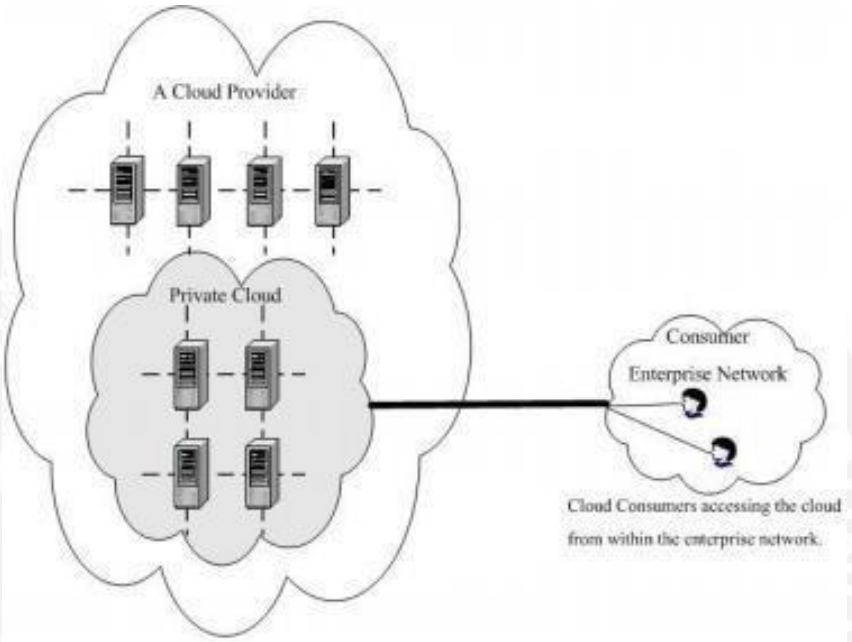


Fig: On-site private clouds

Out-sourced Private Cloud

- Supposed to deliver more efficient and convenient cloud



- Offers higher efficiency, resiliency(to recover quickly), security, and privacy
- **Customer information protection**: In-house security is easier to maintain and rely on.
    - Follows its own(private organization) standard procedures and operations(where as in public cloud standard procedures and operations of service providers are followed)

Advantage

- Offers greater Security and Privacy
- Organization has control over resources
- Highly reliable
- Saves money by virtualizing the resources

Disadvantage

- Expensive when compared to public cloud
- Requires IT Expertise to maintain resources.

3.3.3 Hybrid Cloud

- Built with both public and private clouds

- It is a heterogeneous cloud resulting from a private and public clouds.
- Private cloud are used for
  - sensitive applications are kept inside the organization's network
  - business-critical operations like financial reporting
- Public Cloud are used when
  - Other services are kept outside the organization's network
  - high-volume of data
  - Lower-security needs such as web-based email(gmail,yahoomail etc)
- The resources or services are temporarily leased for the time required and then released. This practice is also known as **cloud bursting.**

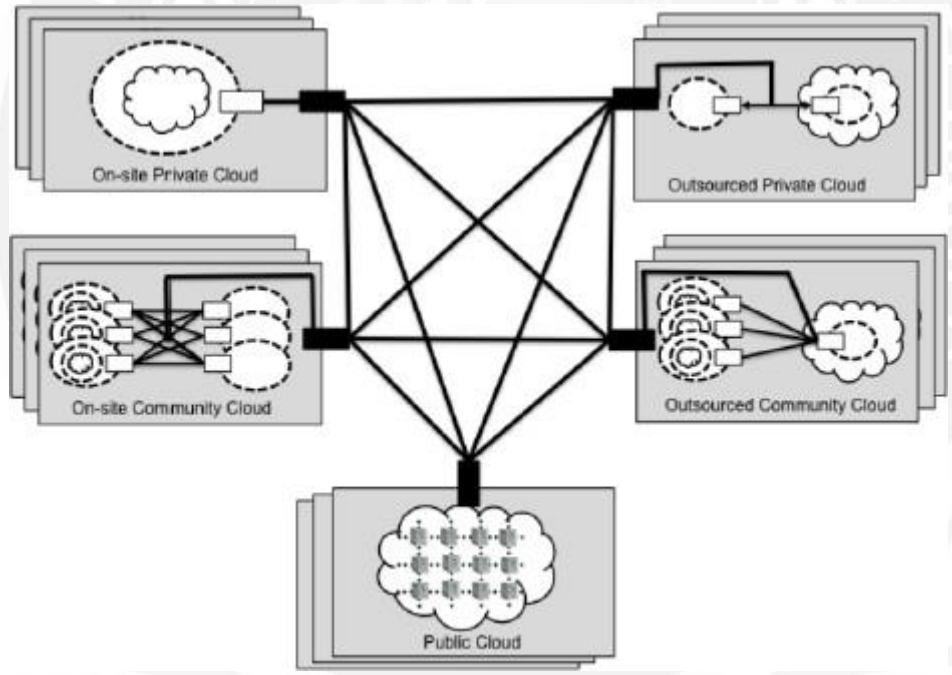


Fig:Hybrid Cloud

Advantage

- It is scalable
- Offers better security
- Flexible-Additional resources are availed in public cloud when needed
- Cost-effectiveness—we have to pay for extra resources only when needed.
- Control - Organisation can maintain a private infrastructure for sensitive application

Disadvantage

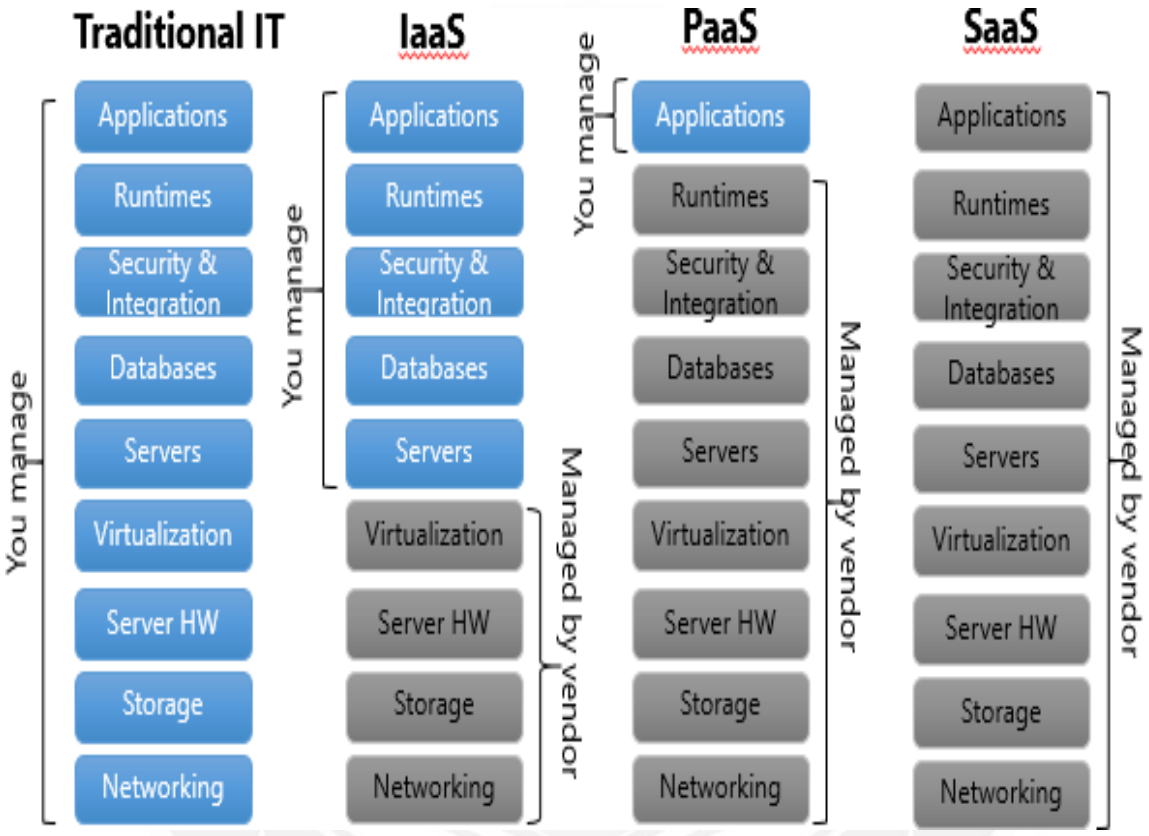
- Infrastructure Dependency

- Possibility of security breach(violate) through public cloud

Difference	Public	Private	Hybrid
Tenancy	**Multi-tenancy:** the data of multiple organizations in stored in a shared environment.	**Single tenancy:** Single organizations data is stored in the cloud.	Data stored in the public cloud is multi-tenant. Data stored in private cloud is Single Tenancy.
Exposed to the Public	Yes: anyone can use the public cloud services.	No: Only the organization itself can use the private cloud services.	Services on private cloud can be accessed only by the organization's users Services on public cloud can be Accessed by anyone.
Data Center Location	Anywhere on the Internet	Inside the organization's network.	Private Cloud- Present in organization's network. Public Cloud - anywhere on the Internet.
Cloud Service Management	Cloud service provider manages the services.	Organization has their own administrators managing services	Organization manages the private cloud. Cloud Service Provider(CSP) manages the public cloud.
Hardware Components	CSP provides all the hardware.	Organization provides hardware.	Private Cloud – organization provides resources. Public Cloud – Cloud service Provider provides.
Expenses	Less Cost	Expensive when compared to public cloud	Cost required for setting up private cloud.

Cloud Service Models

- **S**oftware as a Service (**S**aaS)
- **P**latform as a Service (**P**aaS)
- **I**nfrastructure as a Service (**I**aaS)



These models are offered based on various SLAs between providers and users

SLA of cloud computing covers

o service availability

o performance

- data protection

o Security

3.4.1 Software as a Service(SaaS)(Complete software offering on the cloud)

- SaaS is a licensed software offering on the cloud and pay per use
- SaaS is a software delivery methodology that provides licensed multi-tenant access to software and its functions remotely as a Web-based service. Usually billed based on usage
  - Usually multi tenant environment

- Highly scalable architecture

- Customers do not invest on software application programs.
- 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 a thin client interface such as a web browser (e.g., web-based email).
- The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, storage, data or even individual application capabilities, with the possible exception of limited user specific application configuration settings.
- On the customer side, there is no upfront investment in servers or software licensing.
- It is a "one-to-many" software delivery model, whereby an application is shared across multiple users
- Characteristic of Application Service Provider(ASP)
  - o Product sold to customer is application access.
  - o Application is centrally managed by Service Provider.
  - o Service delivered is one-to-many customers
  - o Services are delivered on the contract
    - E.g. Gmail and docs, Microsoft SharePoint, and the CRM software(Customer Relationship management)
- **SaaS providers**
- Google's Gmail, Docs, Talk etc
- Microsoft's Hotmail, Sharepoint
- SalesForce,
- Yahoo
- Facebook

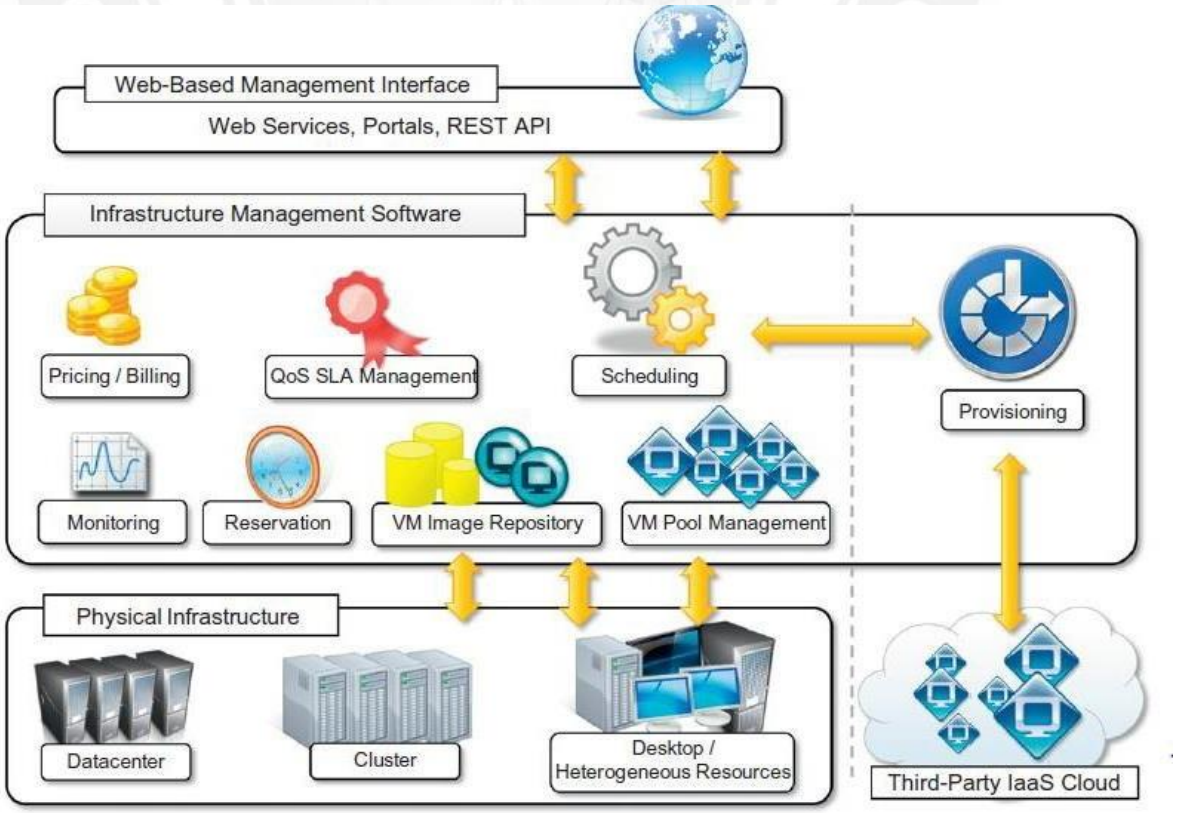
3.4.2 Infrastructure as a Service (IaaS) (Hardware offerings on the cloud)

IaaS is the delivery of technology infrastructure (mostly hardware) as an on demand, scalable service .

- Usually billed based on usage
- Usually multi tenant virtualized environment
- Can be coupled with Managed Services for OS and application support
- User can choose his OS, storage, deployed app, networking components

- The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources.
- Consumer is able to deploy and run arbitrary software, which may 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.

- IaaS/HaaS solutions bring all the benefits of hardware virtualization: workload partitioning, application isolation, sandboxing, and hardware tuning
- **Sandboxing:** A program is set aside from other programs in a separate environment so that if errors or security issues occur, those issues will not spread to other areas on the computer.
- **Hardware tuning:** To improve the performance of system
- The user works on multiple VMs running guest OSes
- the service is performed by rented cloud infrastructure
- The user does not manage or control the cloud infrastructure, but can specify when to request and release the needed resources.



IaaS providers

- Amazon Elastic Compute Cloud (EC2)
  - Each instance provides 1-20 processors, upto 16 GB RAM, 1.69TB storage
- RackSpace Hosting
  - Each instance provides 4 core CPU, upto 8 GB RAM, 480 GB storage
- Joyent Cloud
  - Each instance provides 8 CPUs, upto 32 GB RAM, 48 GB storage
- Go Grid
  - Each instance provides 1-6 processors, upto 15 GB RAM, 1.69TB storage

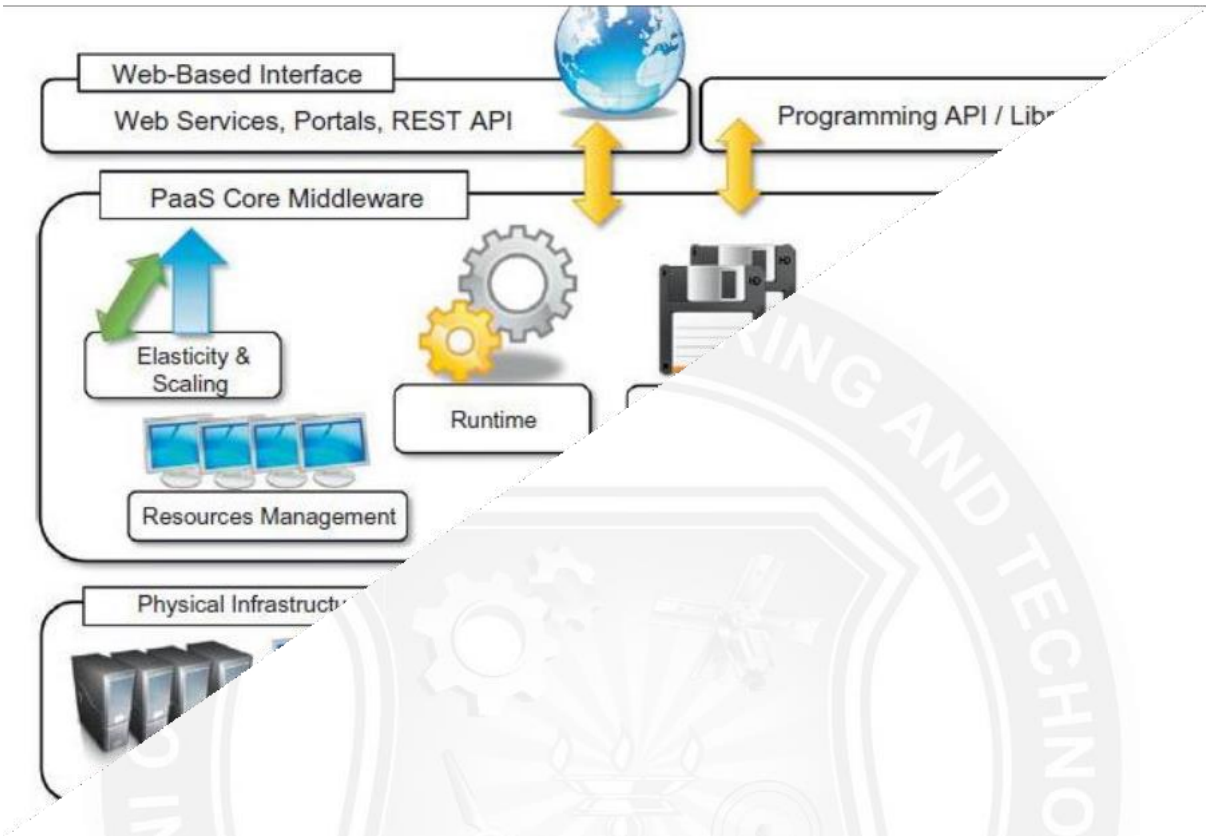
3.4.3 Platform as a Service (PaaS) (Development platform)

- PaaS provides all of the facilities required to support the complete life cycle of building, delivering and deploying web applications and services entirely from the Internet.
- Typically applications must be developed with a particular platform in mind
  - Multi tenant environments
  - Highly scalable multi tier architecture
- The capability provided to the consumer is to deploy onto the cloud infrastructure consumer created or acquired applications created using programming languages and tools supported by the provider.
- The consumer does not manage or control the underlying cloud infrastructure including network, servers, operating systems, or storage.

Have control over the deployed applications and possibly application hosting environment configurations.

Customers are provided with execution platform for developing applications.

- Execution platform includes operating system, programming language execution environment, database, web server, hardware etc.
- This acts as **middleware** on top of which applications are built
- The user is freed from managing the cloud infrastructure



Application management is the core functionality of the middleware

- Provides runtime(execution) environment
- Developers design their applications in the execution environment.
- Developers need not concern about hardware (physical or virtual), operating systems, and other resources.
- PaaS core middleware manages the resources and scaling of applications on demand.
- PaaS offers

o Execution environment and hardware resources (infrastructure) **(or)**

o software is installed on the user premises

- **PaaS:** Service Provider provides Execution environment and hardware resources (infrastructure)

Characteristics of PaaS

- **Runtime framework:** Executes end-user code according to the policies set by the user and the provider.
- **Abstraction:** PaaS helps to deploy(install) and manage applications on the cloud.

 Automation: Automates the process of deploying applications to the infrastructure, additional resources are provided when needed.

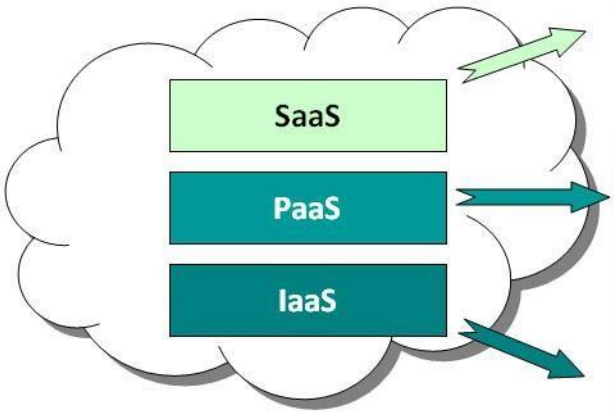
 Cloud services: helps the developers to simplify the creation and delivery cloud applications.

PaaS providers

- Google App Engine
  - Python, Java, Eclipse
- Microsoft Azure
  - .Net, Visual Studio
- Sales Force
  - Apex, Web wizard
- TIBCO,
- VMware,
- Zoho

Cloud Computing – Services

- Software as a Service - SaaS
- Platform as a Service - PaaS
- Infrastructure as a Service - IaaS



Who Uses It	What Services are available	Why use it?
Business Users	EMail, Office Automation, CRM, Website Testing, Wiki, Blog, Virtual Desktop ...	To complete business tasks
Developers and Deployers	Service and application test, development, integration and deployment	Create or deploy applications and services for users
System Managers	Virtual machines, operating systems, message queues, networks, storage, CPU, memory, backup services	Create platforms for service and application test, development, integration and deployment

Category	Description	Product Type	Vendors and Products
PaaS-I	Execution platform is provided along with hardware resources (infrastructure)	Middleware + Infrastructure	Force.com, Longjump
PaaS -II	Execution platform is provided with additional components	Middleware + Infrastructure, Middleware	Google App Engine
PaaS- III	Runtime environment for developing any kind of application development	Middleware + Infrastructure, Middleware	Microsoft Azure