

Infrastructure as a Service (IaaS)

IaaS is also known as **Hardware as a Service (HaaS)**. It is one of the layers of the cloud computing platform. It allows customers to outsource their IT infrastructures such as servers, networking, processing, storage, virtual machines, and other resources. Customers access these resources on the Internet using a pay-as-per use model.

In traditional hosting services, IT infrastructure was rented out for a specific period of time, with pre-determined hardware configuration. The client paid for the configuration and time, regardless of the actual use. With the help of the IaaS cloud computing platform layer, clients can dynamically scale the configuration to meet changing requirements and are billed only for the services actually used.

IaaS cloud computing platform layer eliminates the need for every organization to maintain the IT infrastructure.

IaaS is offered in three models: public, private, and hybrid cloud:

The private cloud implies that the infrastructure resides at the customer-premise.

In the case of public cloud, it is located at the cloud computing platform vendor's data center.

The hybrid cloud is a combination of the two in which the customer selects the best of both public cloud or private cloud.

IaaS provider provides the following services -

Compute: Computing as a Service includes virtual central processing units and virtual main memory for the Vms that is provisioned to the end- users.

Storage: IaaS provider provides back-end storage for storing files.

Network: Network as a Service (NaaS) provides networking components such as routers, switches, and bridges for the Vms.

Load balancers: It provides load balancing capability at the infrastructure layer.



Advantages of IaaS cloud computing layer:

There are the following advantages of IaaS computing layer -

Shared infrastructure:

IaaS allows multiple users to share the same physical infrastructure.

Web access to the resources:

IaaS allows IT users to access resources over the internet.

Pay-as-per-use model:

IaaS providers provide services based on the pay-as-per-use basis. The users are required to pay for what they have used.

Focus on the core business:

IaaS providers focus on the organization's core business rather than on IT infrastructure.

On-demand scalability:

On-demand scalability is one of the biggest advantages of IaaS. Using IaaS, users do not worry about to upgrade software and troubleshoot the issues related to hardware components.

Disadvantages of IaaS cloud computing layer:**Security:**

Security is one of the biggest issues in IaaS. Most of the IaaS providers are not able to provide 100% security.

Maintenance & Upgrade:

Although IaaS service providers maintain the software, but they do not upgrade the software for some organizations.

Interoperability issues:

It is difficult to migrate VM from one IaaS provider to the other, so the customers might face problem related to vendor lock-in.

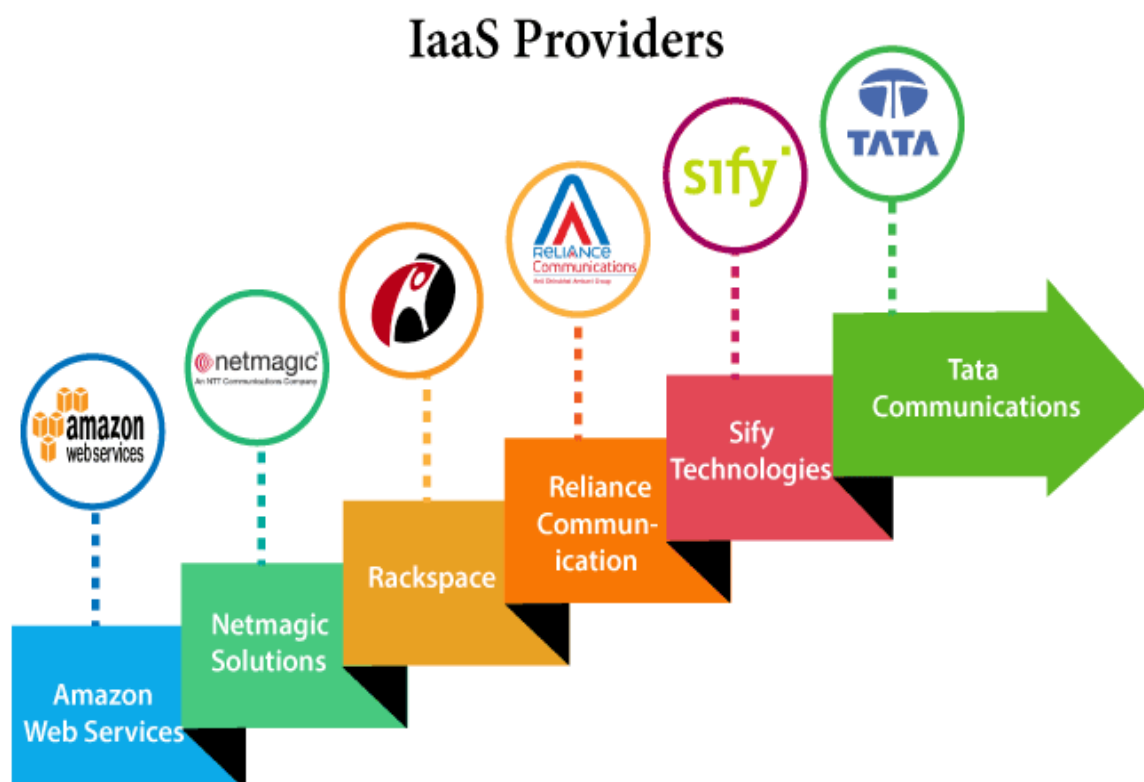
Some important point about IaaS cloud computing layer:

IaaS cloud computing platform cannot replace the traditional hosting method, but it provides more than that, and each resource which are used are predictable as per the usage.

IaaS cloud computing platform may not eliminate the need for an in-house IT department. It will be needed to monitor or control the IaaS setup. IT salary expenditure might not reduce significantly, but other IT expenses can be reduced.

Breakdowns at the IaaS cloud computing platform vendor's can bring your business to the halt stage. Assess the IaaS cloud computing platform vendor's stability and finances. Make sure that SLAs (i.e., Service Level Agreement) provide backups for data, hardware, network, and application failures. Image portability and third-party support is a plus point.

The IaaS cloud computing platform vendor can get access to your sensitive data. So, engage with credible companies or organizations. Study their security policies and precautions.

Top IaaS Providers who are providing IaaS cloud computing platform:

Platform as a Service (PaaS)

Platform as a Service (PaaS) provides a runtime environment. It allows programmers to easily create, test, run, and deploy web applications. You can purchase these applications from a cloud service provider on a pay-as-per use basis and access them using the Internet connection. In PaaS, back end scalability is managed by the cloud service provider, so end-users do not need to worry about managing the infrastructure.

PaaS includes infrastructure (servers, storage, and networking) and platform (middleware, development tools, database management systems, business intelligence, and more) to support the web application life cycle.

Example: Google App Engine, Force.com, Azure.

PaaS providers provide the Programming languages, Application frameworks, Databases, and Other tools:



Programming languages:

PaaS providers provide various programming languages for the developers to develop the applications. Some popular programming languages provided by PaaS providers are Java, PHP, Perl, etc.

Application frameworks:

PaaS providers provide application frameworks to easily understand the application development. Some popular application frameworks provided by PaaS providers are Node.js, Joomla, WordPress, Spring, etc.

Databases:

PaaS providers provide various databases such as ClearDB, PostgreSQL, MongoDB, and Redis to communicate with the applications.

Other tools:

PaaS providers provide various other tools that are required to develop, test, and deploy the applications.

Advantages of PaaS:

There are the following advantages of PaaS -

Simplified Development:

PaaS allows developers to focus on development and innovation without worrying about infrastructure management.

Lower risk:

No need for up-front investment in hardware and software. Developers only need a PC and an internet connection to start building applications.

Prebuilt business functionality:

Some PaaS vendors also provide already defined business functionality so that users can avoid building everything from very scratch and hence can directly start the projects only.

Instant community:

PaaS vendors frequently provide online communities where the developer can get the ideas to share experiences and seek advice from others.

Scalability:

Applications deployed can scale from one to thousands of users without any changes to the applications.

Disadvantages of PaaS cloud computing layer:**Vendor lock-in:**

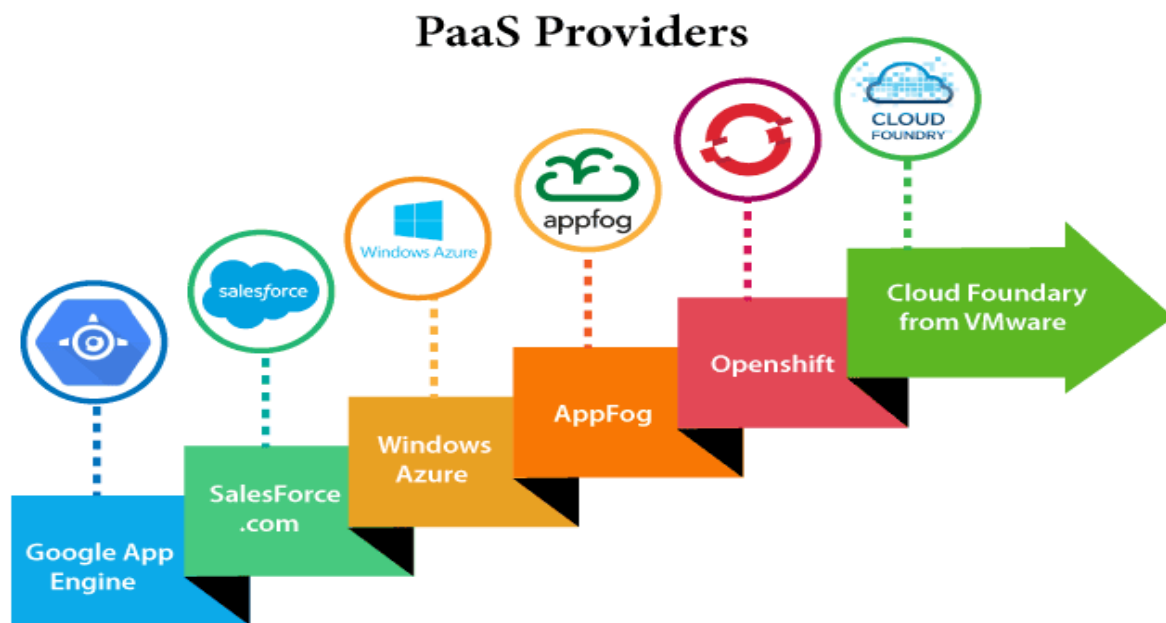
One has to write the applications according to the platform provided by the PaaS vendor, so the migration of an application to another PaaS vendor would be a problem.

Data Privacy:

Corporate data, whether it can be critical or not, will be private, so if it is not located within the walls of the company, there can be a risk in terms of privacy of data.

Integration with the rest of the systems applications:

It may happen that some applications are local, and some are in the cloud. So there will be chances of increased complexity when we want to use data which in the cloud with the local data.

Popular PaaS Providers:

The below table shows some popular PaaS providers and services that are provided by them :-

Providers	Services
Google App Engine (GAE)	App Identity, URL Fetch, Cloud storage client library, Logservice
Salesforce.com	Faster implementation, Rapid scalability, CRM Services, Sales cloud, Mobile connectivity, Chatter.
Windows Azure	Compute, security, IoT, Data Storage.
AppFog	Justcloud.com, SkyDrive, GoogleDocs
Openshift	RedHat, Microsoft Azure.
Cloud Foundry from VMware	Data, Messaging, and other services.

Software as a Service (SaaS)

SaaS is also known as "**On-Demand Software**". It is a software distribution model in which services are hosted by a cloud service provider. These services are available to end-users over the internet so, the end-users do not need to install any software on their devices to access these services.

There are following services provided by SaaS providers -

Business Services - SaaS Provider provides various business services to start-up the business. The SaaS business services include **ERP** (Enterprise Resource Planning), **CRM** (Customer Relationship Management), **billing**, and **sales**.

Document Management - SaaS document management is a software application offered by a third party (SaaS providers) to create, manage, and track electronic documents.

Example: Slack.

Social Networks - As we all know, social networking sites are used by the general public, so social networking service providers use SaaS for their convenience and handle the general public's information.

Mail Services - To handle the unpredictable number of users and load on e-mail services, many e-mail providers offering their services using SaaS.



Advantages of SaaS cloud computing layer:

SaaS is easy to buy:

SaaS pricing is based on a monthly fee or annual fee subscription, so it allows organizations to access business functionality at a low cost, which is less than licensed applications.

Unlike traditional software, which is sold as a licensed based with an up-front cost (and often an optional ongoing support fee), SaaS providers are generally pricing the applications using a subscription fee, most commonly a monthly or annually fee.

One to Many:

SaaS services are offered as a one-to-many model means a single instance of the application is shared by multiple users.

Less hardware required for SaaS:

The software is hosted remotely, so organizations do not need to invest in additional hardware.

Low maintenance required for SaaS:

Software as a service removes the need for installation, set-up, and daily maintenance for the organizations. The initial set-up cost for SaaS is typically less than the enterprise software. SaaS vendors are pricing their applications based on some usage parameters, such as a number of users using the application. So SaaS does easy to monitor and automatic updates.

No special software or hardware versions required:

All users will have the same version of the software and typically access it through the web browser. SaaS reduces IT support costs by outsourcing hardware and software maintenance and support to the IaaS provider.

Multidevice support:

SaaS services can be accessed from any device such as desktops, laptops, tablets, phones, and thin clients.

API Integration:

SaaS services easily integrate with other software or services through standard APIs.

No client-side installation:

SaaS services are accessed directly from the service provider using the internet connection, so do not need to require any software installation.

Disadvantages of SaaS cloud computing layer:**Security:**

Actually, data is stored in the cloud, so security may be an issue for some users. However, cloud computing is not more secure than in-house deployment.

Latency issue:

Since data and applications are stored in the cloud at a variable distance from the end-user, there is a possibility that there may be greater latency when interacting with the application compared to local deployment. Therefore, the SaaS model is not suitable for applications whose demand response time is in milliseconds.

Total Dependency on Internet:

Without an internet connection, most SaaS applications are not usable.

Switching between SaaS vendors is difficult:

Switching SaaS vendors involves the difficult and slow task of transferring the very large data files over the internet and then converting and importing them into another SaaS also.

Popular SaaS Providers:



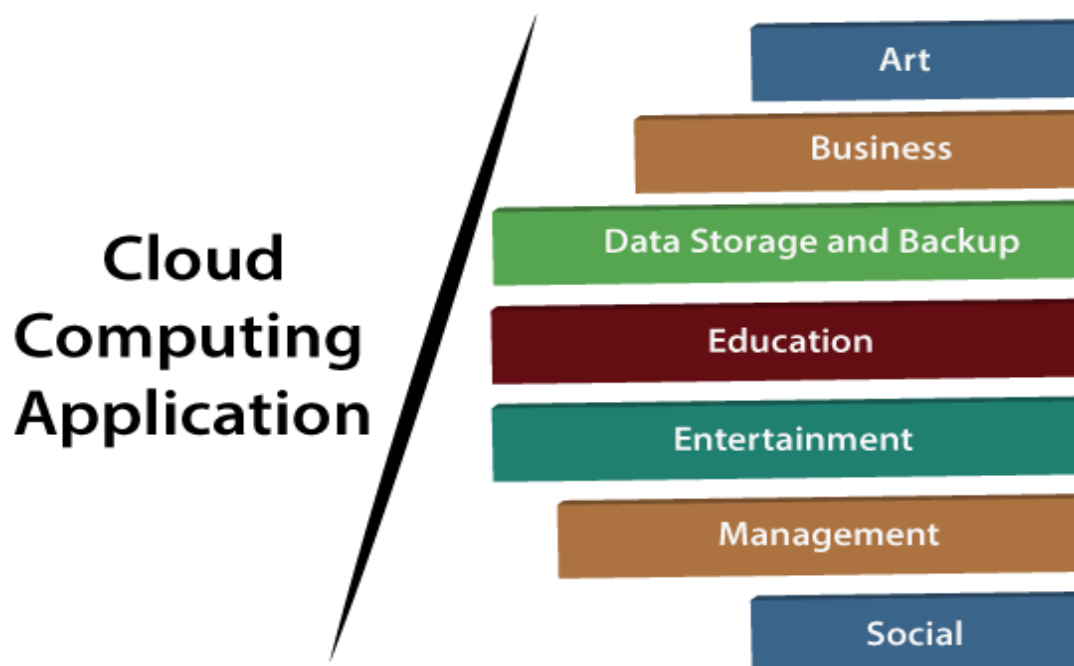
The below table shows some popular SaaS providers and services that are provided by them -

Provider	Services
Salseforce.com	On-demand CRM solutions
Microsoft Office 365	Online office suite
Google Apps	Gmail, Google Calendar, Docs, and sites
NetSuite	ERP, accounting, order management, CRM, Professionals Services Automation (PSA), and e-commerce applications.
GoToMeeting	Online meeting and video-conferencing software
Constant Contact	E-mail marketing, online survey, and event marketing
Oracle CRM	CRM applications
Workday, Inc	Human capital management, payroll, and financial management.

Cloud Computing Applications

Cloud service providers provide various applications in the field of art, business, data storage and backup services, education, entertainment, management, social networking, etc.

The most widely used cloud computing applications are given below -



Art Applications:

Cloud computing offers various art applications for quickly and easily design **attractive cards, booklets, and images**. Some most commonly used cloud art applications are given below:

i Moo

Moo is one of the best cloud art applications. It is used for designing and printing business cards, postcards, and mini cards.

ii. Vistaprint

Vistaprint allows us to easily design various printed marketing products such as business cards, Postcards, Booklets, and wedding invitations cards.

iii. Adobe Creative Cloud

Adobe creative cloud is made for designers, artists, filmmakers, and other creative professionals. It is a suite of apps which includes PhotoShop image editing programming, Illustrator, InDesign, TypeKit, Dreamweaver, XD, and Audition.

Business Applications:

Business applications are based on cloud service providers. Today, every organization requires the cloud business application to grow their business. It also ensures that business applications are 24*7 available to users.

There are the following business applications of cloud computing -

i. MailChimp

MailChimp is an **email publishing platform** which provides various options to **design, send, and save** templates for emails.

ii. Salesforce

Salesforce platform provides tools for sales, service, marketing, e-commerce, and more. It also provides a cloud development platform.

iii. Chatter

Chatter helps us to **share important information** about the organization in real time.

iv. Paypal

Paypal offers the simplest and easiest **online payment** mode using a secure internet account. Paypal accepts the payment through debit cards, credit cards, and also from Paypal account holders.

v. Slack

Slack stands for **Searchable Log of all Conversation and Knowledge**. It provides a **user-friendly** interface that helps us to create public and private channels for communication.

vi. Quickbooks

Quickbooks works on the terminology "**Run Enterprise anytime, anywhere, on any device.**" It provides online accounting solutions for the business. It allows more than 20 users to work simultaneously on the same system.

Data Storage and Backup Applications:

Cloud computing allows us to store information (data, files, images, audios, and videos) on the cloud and access this information using an internet connection. As the cloud provider is responsible for providing security, so they offer various backup recovery application for retrieving the lost data.

A list of data storage and backup applications in the cloud are given below -

i. Box.com

Box provides an online environment for **secure content management, workflow, and collaboration**. It allows us to store different files such as Excel, Word, PDF, and images on the cloud. The main advantage of using box is that it provides drag & drop service for files and easily integrates with Office 365, G Suite, Salesforce, and more than 1400 tools.

ii. Mozy

Mozy provides powerful **online backup solutions** for our personal and business data. It schedules automatically back up for each day at a specific time.

iii. Google G Suite

Google G Suite is one of the best **cloud storage and backup** application. It includes Google Calendar, Docs, Forms, Google+, Hangouts, as well as cloud storage and tools for managing cloud apps. The most popular app in the Google G Suite is Gmail. Gmail offers free email services to users.

Education Applications:

Cloud computing in the education sector becomes very popular. It offers various **online distance learning platforms** and **student information portals** to the students. The advantage of using cloud in the field of education is that it offers strong virtual classroom environments, Ease of accessibility, secure data storage, scalability, greater reach for the students, and minimal hardware requirements for the applications.

There are the following education applications offered by the cloud -

i. Google Apps for Education

Google Apps for Education is the most widely used platform for free web-based email, calendar, documents, and collaborative study.

ii. Chromebooks for Education

Chromebook for Education is one of the most important Google's projects. It is designed for the purpose that it enhances education innovation.

iii. Tablets with Google Play for Education

It allows educators to quickly implement the latest technology solutions into the classroom and make it available to their students.

iv. AWS in Education

AWS cloud provides an education-friendly environment to universities, community colleges, and schools.

Entertainment Applications:

Entertainment industries use a **multi-cloud strategy** to interact with the target audience. Cloud computing offers various entertainment applications such as online games and video conferencing.

i. Online games

Today, cloud gaming becomes one of the most important entertainment media. It offers various online games that run remotely from the cloud. The best cloud gaming services are Shaow, GeForce Now, Vortex, Project xCloud, and PlayStation Now.

ii. Video Conferencing Apps

Video conferencing apps provides a simple and instant connected experience. It allows us to communicate with our business partners, friends, and relatives using a

cloud-based video conferencing. The benefits of using video conferencing are that it reduces cost, increases efficiency, and removes interoperability.

Management Applications

Cloud computing offers various cloud management tools which help admins to manage all types of cloud activities, such as resource deployment, data integration, and disaster recovery. These management tools also provide administrative control over the platforms, applications, and infrastructure.

Some important management applications are -

i. Toggl

Toggl helps users to track allocated time period for a particular project.

ii. Evernote

Evernote allows you to sync and save your recorded notes, typed notes, and other notes in one convenient place. It is available for both free as well as a paid version.

It uses platforms like Windows, macOS, Android, iOS, Browser, and Unix.

iii. Outright

Outright is used by management users for the purpose of accounts. It helps to track income, expenses, profits, and losses in real-time environment.

iv. GoToMeeting

GoToMeeting provides **Video Conferencing** and **online meeting apps**, which allows you to start a meeting with your business partners from anytime, anywhere using mobile phones or tablets. Using GoToMeeting app, you can perform the tasks related to the management such as join meetings in seconds, view presentations on the shared screen, get alerts for upcoming meetings, etc.

Social Applications:

Social cloud applications allow a large number of users to connect with each other using social networking applications such as **Facebook, Twitter, LinkedIn**, etc.

There are the following cloud based social applications -

i. Facebook

Facebook is a **social networking website** which allows active users to share files, photos, videos, status, more to their friends, relatives, and business partners using

the cloud storage system. On Facebook, we will always get notifications when our friends like and comment on the posts.

ii. Twitter

Twitter is a **social networking** site. It is a **microblogging** system. It allows users to follow high profile celebrities, friends, relatives, and receive news. It sends and receives short posts called tweets.

iii. LinkedIn

LinkedIn is a **social network** for students, freshers, and professionals.