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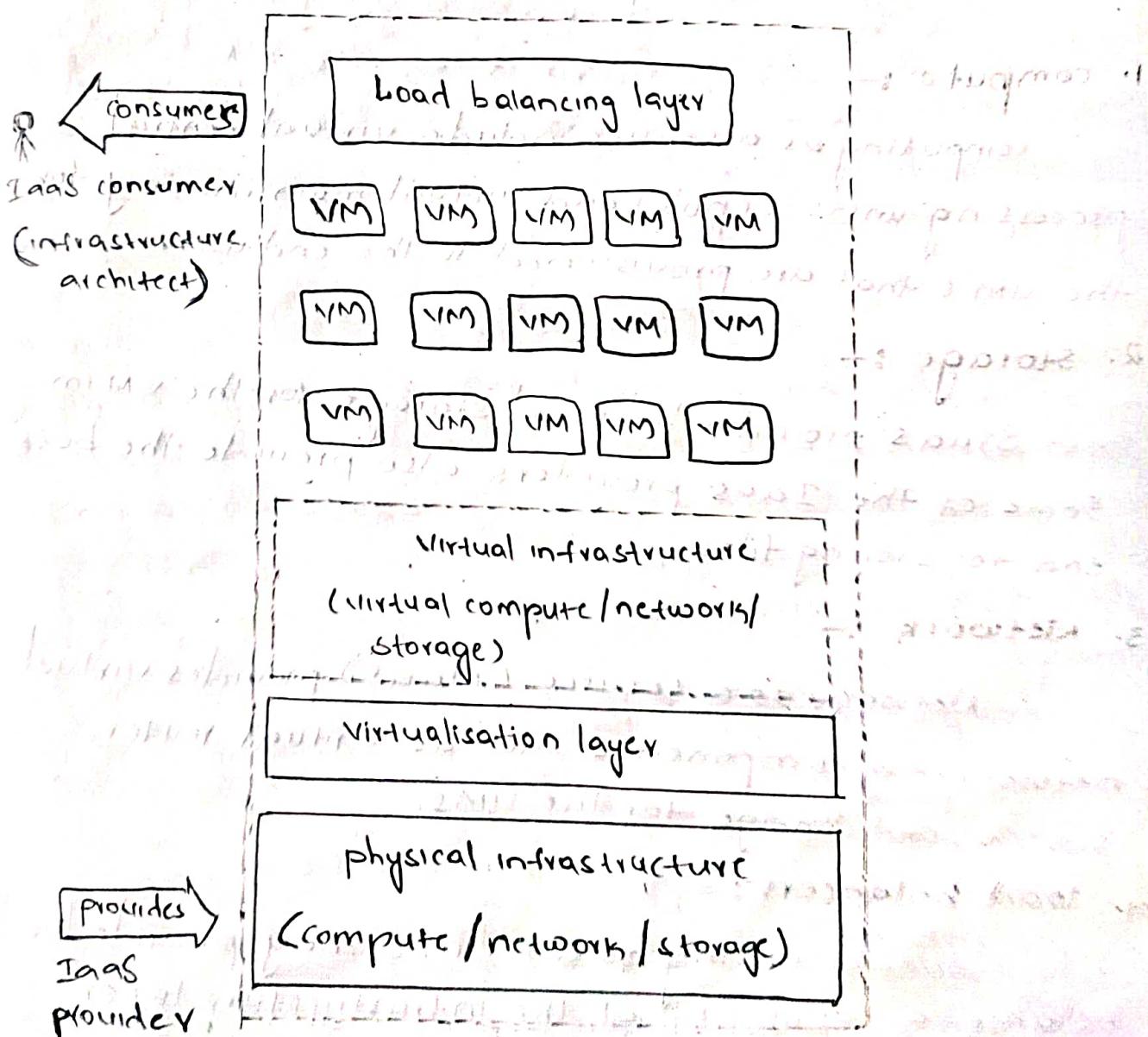
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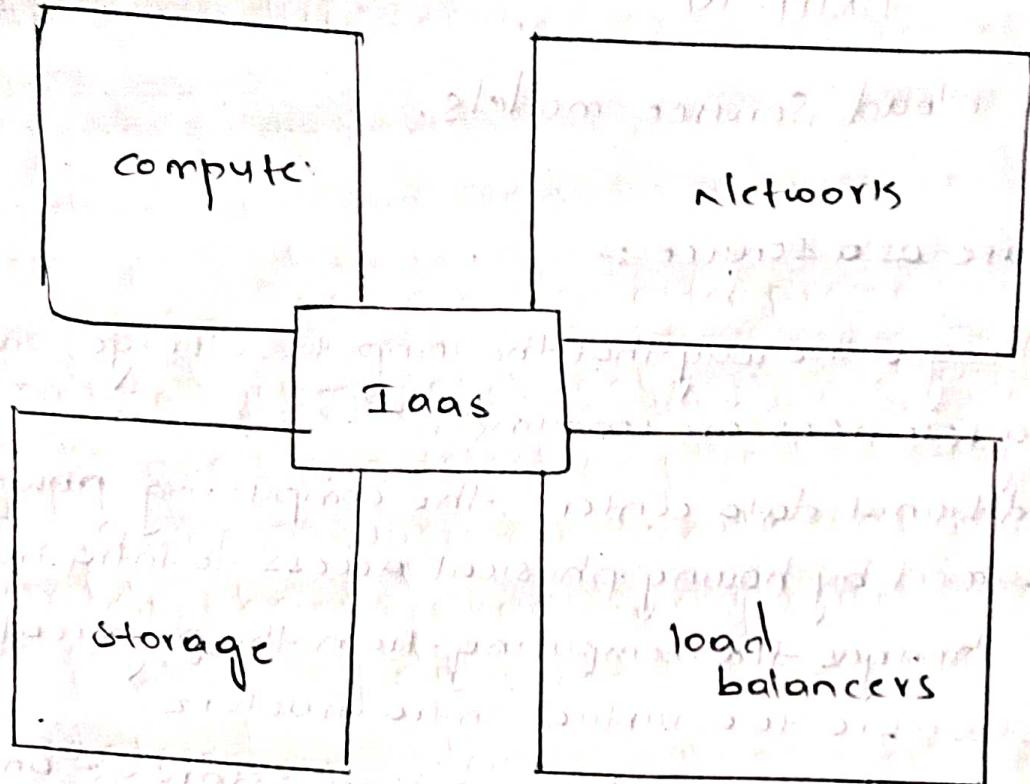
cloud service models.

infrastructure as a service :-

IaaS changes the way that the compute, storage, and networking resources are consumed.

- In traditional data centers, the computing power is consumed by having physical access to infrastructure.
- IaaS changes the computing from the physical infrastructure to a virtual infrastructure.
- IaaS provides virtual computing, storage, and network resources by abstracting the physical resource.





services provided by IaaS providers

1. compute :-

computing as a service include virtual central processing units (cpus) and virtual main memory for the VM's that are provisioned to the end users.

2. storage :-

IaaS provides backend storage for the VM images. Some of the IaaS providers also provide the backend for storing files.

3. Network :-

Network as a service (NaaS) provides virtual networking components such as virtual router, switch, and bridge for the VMs.

4. load balancers :-

load balancing as a service may provide load balancing capability at the infrastructure layer.

Characteristics of IaaS :-

IaaS has its own unique characteristics as follows:-

1. Web access to the resources :-

The IaaS model enables the IT users to access infrastructure resources over the internet. When accessing a huge computing power, the IT user need not get physical access to the servers. Through any web browser or management console, the users can access the required infrastructure.

2. centralized management :-

Even though the physical resources are distributed the management will be from a single place. The resources distributed across different parts can be controlled from any management console. This ensures effective resource management and effective resource utilization.

3. elasticity and dynamic scaling :-

IaaS provides elastic services where the usage of resources can be increased or decreased according to the requirements. The infrastructure need depends on the load on the application.

According to the load, IaaS services can provide the resources. The load on any application is dynamic and IaaS services are capable of provisioning the required services dynamically.

4. Shared infrastructure :-

IaaS follows a one-to-many delivery model and allows multiple IT users to share the same physical infrastructure. The different IT users

will be given different VMs. IaaS ensures high resource utilization.

5. Pre-configured VMs :-

IaaS providers offer pre-configured VMs with operating systems (OSs), network configuration, etc. The IT users can select any kind of VMs of their choice. The IT users are free to configure VMs from scratch. The users can directly start using the VMs as soon as they subscribed to the services.

6. Metered services :-

IaaS allows the IT users to rent the computing resources instead of buying it. The service consumed by the IT user will be measured, and the users will be charged by the IaaS providers based on the amount of usage.

Suitability of IaaS

IaaS reduces the total cost of ownership (TCO) and increases the return on investment (ROI) for start-up companies that cannot invest more in buying infrastructure.

IaaS can be used in following situations:

1. unpredictable spikes in usage :-

When there is a significant spike in usage of computing resources, IaaS is the best option for IT industries. When demand is very volatile, we cannot predict the spikes and troughs in terms of demand of the infrastructure. In this situation, we cannot add or remove infrastructure immediately according to the demand in a traditional infrastructure. If there is an unpredictable demand of infrastructure, then it is recommended to use IaaS services.

2. limited capital investment :-

New start-up companies cannot invest more on buying infrastructure for their business needs. And so by using IaaS, start-up companies can reduce the capital investment on hardware. IaaS is the suitable option for start-up companies with less capital investment on hardware.

3. Infrastructure on demand :-

Some organisations may require large infrastructure for a short period of time. For this purpose, an organisation cannot afford to buy more on-premise resources. Instead they ~~cannot~~ rent the required infrastructure for a specific period of time. IaaS best suits the organisations that look for infrastructure on demand or for a short period of time.

pros and con's of IaaS :-

Being one of the important service models of cloud computing, IaaS provides lot of benefits for the IT users. The following are the benefits provided by IaaS.

1. Pay-as-you-use model :-

The IaaS services are provided to the customers on a pay-per-use basis. This ensures that the customers are required to pay for what they have used. This model eliminates the unnecessary spending on buying hardware.

2. Reduced TCO :-

Since IaaS providers allow the IT users to rent the computing resources, they need not buy physical hardware for running their business. The IT users can rent the IT infrastructure rather than buy it by spending large amount. IaaS reduces the need for buying hardware resources and thus reduces the TCO.

3. Elastic resources :-

IaaS provides resources based on the current needs. IT users can scale up or scale down the resources whenever they want. This dynamic scaling is done automatically using some load balancers. This load balancer transfers the additional resource request to the new server and improves application efficiency.

4. Better resource utilization :-

Resource utilization is the most important criteria to succeed in the IT business. The purchased infrastructure should be utilized properly to increase the ROI. IaaS ensures better resource utilization and provides high ROI for IaaS providers.

5. supports Green IT :-

In traditional IT infrastructure, dedicated servers are used for different business needs. Since many servers are used, the power consumption will be high. This does not result in green IT. In IaaS, the need of buying dedicated servers is eliminated as single infrastructure is shared b/w multiple customers, thus reducing the number of servers to be purchased and hence the power consumption that results in green IT.

Even though IaaS provides cost-related benefits to small-scale industries, it lacks in providing security to the data.

The following are the drawbacks of IaaS:

1. security issues :-

Since IaaS uses virtualization as the enabling technology, hypervisors play an important role. There are many attacks that target the hypervisors to compromise i.e. if hypervisors get compromised, then any VM's can be attacked easily. Most of the IaaS providers are not able to provide 100% secure to the VM's and the data stored on VM's.

2. interoperability issues :-

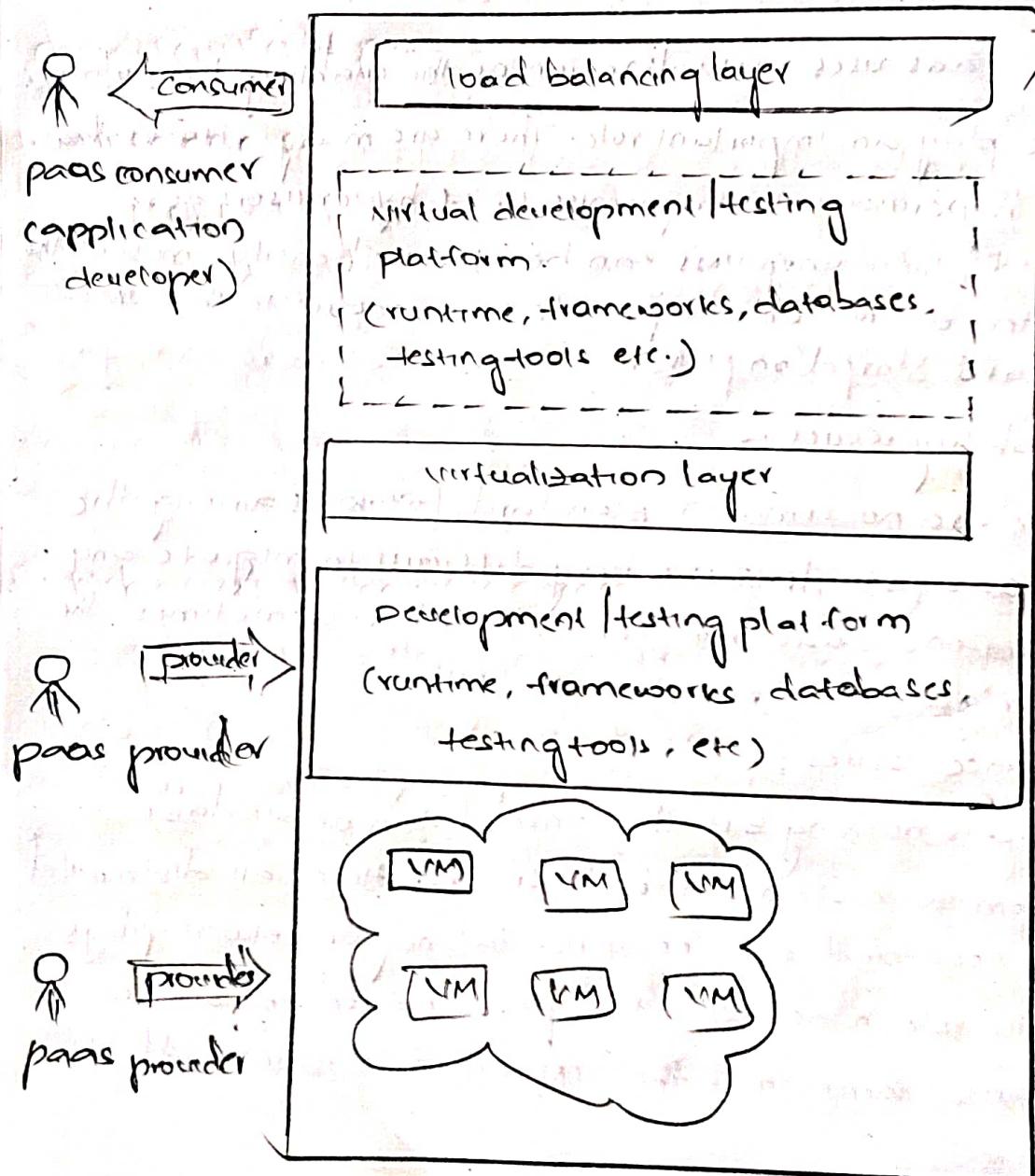
There are no common standards followed among the different IaaS providers. It is very difficult to migrate any VM from one IaaS provider to the other. Sometimes, the customers might face vendor lock-in problem.

3. performance issues :-

IaaS is nothing but the consolidation of available resources from the distributed cloud servers. Here, all distributed servers are connected over network. Latency of network plays an important role in deciding the performance. Because of latency issues, sometimes the VM contains issues with its performances.

Platform as a service :-

- paas changes the way that the software is developed and deployed. in traditional application development, the application will be developed locally and will be hosted in central location. in stand-alone application development, the applications will be developed and delivered as executables. most of the application developed by traditional development platforms results in a licensing-based software, whereas paas changes application development from local machine to online. paas providers provide the development paas from data center. the developers can consume the services over the internet as shown in fig.



Overview of paas.

paaS allows the developers to develop their applications online and also allows them to deploy immediately on the same platform. paaS consumers or developers can consume language runtimes, application frameworks, databases, message queues, testing tools, and deployment tools as a service over the internet. thus, it reduces the complexity of buying and maintaining different tools for developing an application.

1. programming languages :-

paaS providers provide a wide variety of programming languages for the developers to develop applications. some of the popular programming languages provided by paaS vendors are java, perl, PHP, python, Ruby, Scala, ^{clojure}, erlang, and c.

2. Application-framework :-

paaS vendors provide application-frameworks that simplify the application development. some of the popular application development frameworks provided by a paaS provider include Node.js, rails, drupal, joomla, wordpress, django, eej, spring, play, sinatra, Sinatra, Rack and zend.

3. Database :-

Since every application needs to communicate with the databases, it becomes a must-have tool for every application. paaS providers are providing databases also with their paaS platforms. the popular databases provided by popular paaS vendors are cleardb, postgreSQL, cloudant, membase, mongoDB, and Redis.

4. other-tools :-

paaS providers provide all the tools that are required to develop, test, and deploy an application.

programming languages

Application frameworks

paaS

Databases

other tools

services provided by paas provider

characteristics of paas :-

1. All in one :-

Most of the paas providers offers services to developers, deploy, host, and maintain applications in the same IDE. Additionally, many service providers provide all programming languages, frameworks, databases and other development-related services that make developers choose from a wide variety of development platforms.

2. Web access to the development platform :-

A typical development platform uses any IDE's for developing applications. Typically, the IDE will be installed in the developer's machines. But paas provides web access to the development platform. Using web UI, any developer can get access to the development platform. The web-based UI helps the developers create, modify, test, and deploy different applications on the same platform.

3. Offline access :-

A developer may not be able to connect to the internet for a whole day to access the PaaS services. When there is no internet connectivity, the developers should be allowed to work offline. To enable offline development, some of the PaaS providers allow the developer to synchronize their local IDE with the PaaS services. The developers can develop an application locally and deploy it online whenever they are connected to the internet.

4. Built-in scalability :-

Scalability is an important requirement for the new-generation web or SaaS applications. It is very difficult to enable the dynamic scalability for any application developed using traditional development platforms. But, PaaS services provide built-in scalability to an application that is developed using any particular PaaS. This ensures that application is capable of handling varying loads efficiently.

5. Collaborative platform :-

Nowadays, the development team consists of developers who are working from different places. There is a need for a common platform where the developers can collaboratively work together on same project. Most of the PaaS services provide support for collaborative development. To enable collaboration among developers, most of PaaS providers provide tools for project planning & communication.

6. Diverse client tools :-

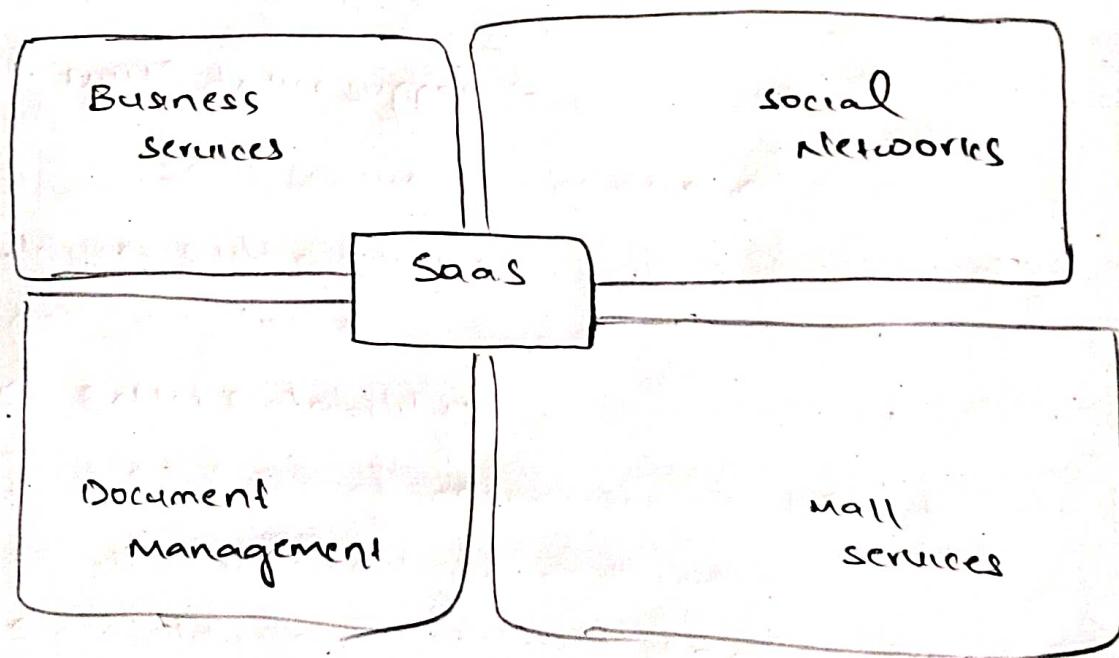
To make the development easier, PaaS providers provide a wide variety of client tools to help developer. The client tools include CLI, web CLI, web UI, REST API, IDE. The developers can choose any tools of their choice. These client tools are also capable of handling subscription management.

Software as a service :-

SaaS changes the way the software is delivered to customers. In the traditional SW model, the SW is delivered as a license-based product that needs to be installed in end user device. Since SaaS is delivered as an on-demand service over the internet, there is no need to install the SW to the end user's device. SaaS services can be accessed or disconnected at any time based on the end user's needs.

SaaS services can be accessed from any lightweight web browsers on any devices such as laptops, tablets, and smartphones. Some of the SaaS services can be accessed from a thin client that does not contain much storage space and cannot run much software like the traditional desktop PCs. The important benefits using thin clients for accessing SaaS application are as follows:

It is less vulnerable to attack, has a longer life cycle, consumes less power and is less expensive.



Services provided by SaaS.

1. Business Services :-

Most of the SaaS providers started providing a variety of business services that attracts start-up companies. The business SaaS services include ERP, CRM, billing, sales, and human resources.

2. Social Networks :-

Since social networking sites are extensively used by general public, many social networking service providers adopted SaaS for their sustainability. Since the number of users of social networking sites is increasing exponentially, cloud computing is the perfect match for handling variable load.

3. Document management :-

Since most of the enterprises extensively use electronic documents, most of the SaaS providers started providing services that are used to create, manage, and track electronic documents.

4. Mail services :-

E-mail services are currently used by many people. The future growth in e-mail usage is unpredictable. To handle the unpredictable number of users and the load on e-mail services; most of the e-mail providers started offering their services as SaaS services.

Characteristics of SaaS :-

1. one-to-many :-

SaaS services are delivered as a one-to-many model where a single instance of the application can be shared by multiple tenants or customers.

2. web access :-

SaaS services provide web access to the software. It allows the end user to access the application from any location if the device is connected to internet.

3. centralized management :-

Since SaaS services are hosted and managed from the central location, management of SaaS application becomes easier. Normally, the SaaS providers will perform the automatic updates that ensure that each tenant is accessing the most recent version of application without any user-side updates.

4. Multi-device support :-

SaaS services can be accessed from any end user devices such as desktops, laptops, tablets, smartphones, and thin clients.

5. Better scalability :-

Since most of the SaaS services leverage PaaS and IaaS for its development and deployment, it ensures a better scalability than traditional S/W. The dynamic scaling of underlying cloud resources makes SaaS applications work efficiently even with varying loads.

6. High availability :-

SaaS services ensure the 99.99% availability of user data as proper backup and recovery mechanisms are implemented at the back end.

7. API integration :-

SaaS services have the capability of integrating with other SaaS or service through standard APIs.

Pros and cons of SaaS :-

1. No client-side installation :-

SaaS services do not require client-side installations on the SaaS. The end users can access the services directly from the service provider data center without any installation. There is no need of high-end hardware to consume SaaS services. It can be accessed from thin clients or any handheld devices, thus reducing the initial expenditure on buying high-end hardware.

2. Cost savings :-

Since SaaS services follow the utility-based billing or pay-as-you-go billing, it demands the end users to pay for what they have used. Most of the SaaS providers offer different subscription plans to benefit different customers. Sometimes, the generic SaaS services such as word processors are given for free to the end users.

3. Less maintenance :-

SaaS services eliminate the additional overhead of maintaining the software from the client side. For example, in traditional software, the end user is responsible for

performing bulk updates. but in SaaS, the service provider itself maintains the automatic updates, monitoring, and other maintenance activities of the applications.

4. Ease of access :-

SaaS services can be accessed from any devices if it is connected to the internet. Accessibility of SaaS services is not restricted to any particular devices. It is adaptable to all the devices as it uses the responsive web UI.

5. Dynamic scaling:-

SaaS services are popularly known for elastic dynamic scaling. It is very difficult for on-premise software to provide dynamic scaling capability as it requires additional hardware. Since the SaaS services leverage elastic resources provided by cloud computing, it can handle any type of varying loads without disrupting the normal behaviour of the application.

6. Disaster recovery :-

With proper backup and recovery mechanisms, replicas are maintained for every SaaS services. The replicas are distributed across many servers. If any server fails, the end user can access the SaaS from other servers. It eliminates the problem of single point of failure. It also ensures the high availability of application.

7. Multitenancy :-

Multitenancy is the ability given to the end users to share a single instance of the application. multitenancy increases resource utilization from service provider side.

1. Security :-

Security is the major concern in migrating to SaaS application. Since the SaaS application is shared by many end users, there is a possibility of data leakage. Here, the data are stored in the service provider data center. We cannot simply trust some third-party service provider to store our company-sensitive and confidential data. The end user should be careful while selecting the SaaS provider to avoid unnecessary data loss.

2. Connectivity requirements:-

SaaS applications require internet connectivity for accessing it. Sometimes, the end-user's internet connectivity might be very slow. In such situations, the user cannot access the services with ease. The dependency on high-speed internet connection is a major problem in SaaS applications.

3. Loss of control:-

Since the data are stored in a third-party and off-premise location, the end-user does not have any control over the data. The degree of control over the SaaS application and data is lesser than the on-premise application.

Other cloud service models :-

The basic cloud services such as IaaS, PaaS, and SaaS are widely used by many individual and start-up companies. Now, cloud computing becomes the dominant technology that drives the IT world.

Many service providers already started offering separate services such as network, desktop, database, and storage on demand as given in the following:-

1. NaaS is an ability given to the end users to access virtual network services that are provided by the service provider. Like other cloud service models, NaaS is also a business model for delivering virtual N/W services over the internet on a pay-per-use basis. In on-premise data center, the IT industries spend a lot of money to buy N/W hardware to manage in-house networks. But cloud computing changes networking services into a utility-based service.

Some of the popular services provided by NaaS include virtual private network (VPN), bandwidth on demand (Bod), and mobile N/W virtualisation.

2. Desktop as a service (DaaS) is an ability given to the end users to use desktop virtualisation without buying and managing their own infrastructure. The end users are responsible for managing their own desktop images, applications and security.

3. SaaS is an ability given to end users to store data on storage services provided by service provider. SaaS allows the end users to access the files at any time from any place. SaaS is also a cloud business model that is delivered as a utility. SaaS is commonly used as backup storage for efficient disaster recovery.

4. DBaaS is an ability given to end users to access database service without the need to install and maintain it. The service provider is responsible for installing and maintaining databases.

DBaaS automates the database administration process. The DBaaS eases the database administration process. popular examples of DBaaS include simpleDB, dynamoDB, MongoDB as a service

5. Data as a service (DaaS) is an ability given to end users to access the data that are provided by service provider over the internet. DaaS provides data on demand. The data may include text, images, sounds & videos. DaaS is highly used in geography data services and financial data services. The advantages of DaaS include agility, cost effectiveness, and data quality.

6. SECaas is an ability given to end user to access security service provided by service provider on a pay-per use basis.

generally, the SECaas includes authentication, antivirus, intrusion detection, security event management

some of SECaas providers include cisco, McAfee, panda, Symantec, trend micro, verisign.

7. IDaaS is an ability given to end users to access the authentication infrastructure that is managed & provided by a third-party service provider.

The end user of IDaaS is typically an organization or enterprise.

generally, IDaaS includes directory services, federated services, registration, authentication services, risk and threat monitoring, identity and profile management