UNIT 2 Collaborating using Cloud services

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- ➢ **Software as a services**
- ➢ **Platform as a services**
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1.1 Introduction of Cloud Services

Nowadays, every successful organization has a presence over the internet for which they require a data center irrespective of their size. The traditional is on-premises, meaning that all its functionality is carried out in a physical site within enterprise office space. A data center might be a few computers under a desk, a climate-controlled room filled with blade servers, or a whole building. It is managed by an in-house IT team employed and paid for by the enterprise which owns the data center.

Now, imagine when you want to create a simple website or digitize whole business processes, apart from building applications, you also need to create a data center for an organization. This means you will have to buy hardware (servers), software, and its

licenses, create a network, build infrastructure, and hire a team of experts to manage or maintain this data center. Before setting up the data center, you need to do an assessment on how many servers you need, there will be chances that you might over-provision or under-provision hardware.

What if you don't have to worry about setting up your own data center and just focus on building applications? This is where Cloud Computing comes into the picture. Let us now understand what Cloud Computing is with examples in this article.
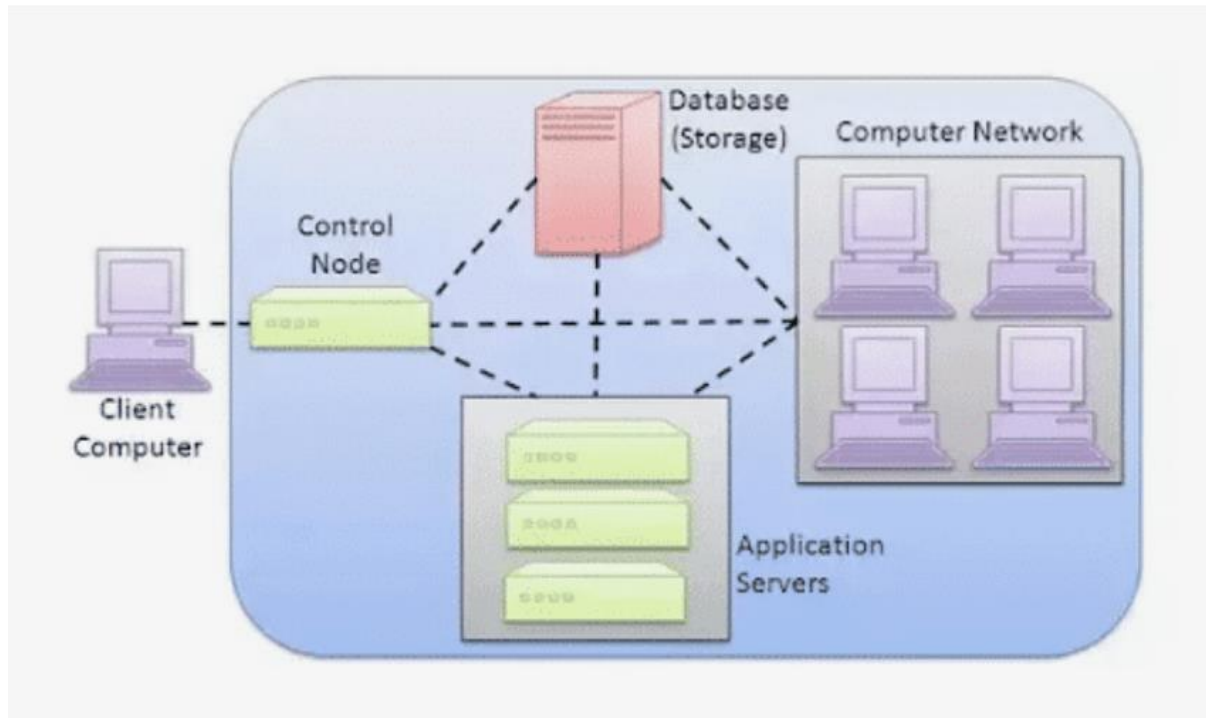
What is Cloud Computing?

Cloud Computing is the delivery of computing services such as servers, data storage, databases, networking, software, analytics, and intelligence over the internet ("cloud") to offer flexible resources, faster innovation, and economies of scale. In simpler terms, instead of owning data centers, organizations can rent access to someone else's infrastructure like storage, computing servers, and databases from a service provider and only pay for resources that they use.

You only need to pay for the cloud services that you use, which helps lower your operating costs, run infrastructure more efficiently, and scale your applications as per business needs.

Who Uses Cloud Computing?

Organizations of different types, sizes, and industries are using the cloud for a wide variety of use cases, such as building customer-facing web applications, data backup, sending email/SMS notifications, virtual desktops, software development and testing, big data analytics, and disaster recovery. For example, Telecom companies are using cloud services to connect with their customers by sending different types of communications. Financial services companies are using the cloud to power real-time fraud detection and prevention.

How Does Cloud Computing Work?

To understand how Cloud Computing works, let us divide it into two sections- Front end and Back end. The front end consists of the client's computer or computer network. The front end consists of the client's computer or computer network. The back end consists of various computers, servers and data storage systems that make up the cloud. They are connected to each other through a network, usually the Internet. The front end is the side of the computer user or client. The back end is 'the cloud' section of the system.

Cloud Computing Deployment Models

The deployment models specify different types of clouds. Every organization has different needs, they need to determine which cloud deployment model will work for them. There are mainly three cloud deployment models:

1. Public Cloud

The public cloud is a set of hardware, networking, storage, services, applications, and interfaces owned and operated by a third party for use by other companies or individuals. You access these services and manage your account using a web browser. These commercial providers create a highly scalable data center that hides the details of the underlying infrastructure from the consumer.

2. Private Cloud

A private cloud is a set of hardware, networking, storage, services, applications, and interfaces owned and operated by an organization for the use of its employees, partners, or customers. A private cloud can be created and managed by a third party for the exclusive use of one enterprise. The private cloud is a highly controlled environment not open for public consumption. It is essentially just another way of running an on-premises data center.

3. Hybrid Cloud

A hybrid cloud is a combination of a private cloud combined with the use of public cloud services where the two cloud environments work together to solve business problems. By allowing data and applications to move between private and public clouds, a hybrid cloud gives your business greater flexibility, more deployment options and helps optimize your existing infrastructure, security, and compliance.

The goal is to create a hybrid cloud environment that can combine services and data from a variety of cloud models to create a unified, automated, and well-managed computing environment.

Types of Cloud Services

Cloud Computing services are divided into three classes, according to the abstraction level of the capability provided and the service model of providers:

1. Infrastructure as a Service (IaaS in Cloud Computing)

The capability provided to the consumer is to provision processing, storage, networks, and other fundamental computing resources. 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).

2. Platform as a Service (PaaS in Cloud Computing)

The capability provided to the consumer is to deploy onto the Cloud infrastructure consumer-created or acquired applications 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.

3. Software as a Service (SaaS in Cloud Computing)

The capability provided to the consumer is their applications running on a Cloud infrastructure. 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 e-mail), 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, apart from limited user-specific application configuration settings.

Cloud Computing Examples and Use Cases

If you use an online service to send email, edit documents, watch movies or TV (like Netflix), listen to music, play games, or store pictures and other files, it is likely that you are part of cloud eco-system, as Cloud Computing is making it all possible behind the scenes. There are many use cases of Cloud Computing, few are mentioned below:

1.3 What is Software as a Service?

Whenever you need it, you can get it to the type of ready-to-use software service where a user only pays for the service they use or need. It is a method for the provider to distribute the services as and when needed. This model is among the three main or essential cloud-based models.

Infrastructure as a Service (IaaS) and Platform as a service (PaaS) are the other two. As all servers and databases are sustained by the users' provider, using this type of architecture has various benefits for the user, the primary among them being the reduction in operational costs and sustenance costs.

Working of SaaS

This cloud-based system allows users to access internet-based applications offered by providers on demand. SaaS is delivered through a centralized network of sensors and servers connected to a remote database.

SaaS can be hosted on the proprietary owned sensors, servers, and the provider's database or outsourced and hosted by the Independent Software Vendor (ISV). The provider of

these types of services is often called the Application Service Provider (ASP). The ASP can host a user application and allow its conveyance to authorized users over the internet, ensuring the service's security.

Thus, these users are not required to maintain or set up their network. They only pay the required fee for their usage and get going on using the application.

The provider provides users with network-based access to the service, and the users' data is stored either on their local database or in the cloud, and often sometimes, a mixture of both is used.

The users can combine different tools using the API. Organizations or users can create their proprietary software and integrate it with the SaaS-based systems; moreover, they can interconnect multiple SaaS-based applications.

What is the structure of SaaS?

Its architecture is a type of software delivery where the provider or vendor hosts the application on a cloud server and delivers the finished, ready-to-use application to the user. The server is centrally maintained and common for its users. This means the access to the application is provided to the users by providing them access to the cloud server, and various users use the common cloud server to perform the necessary computation and complete the required tasks.

Organizations or users also develop their in-house applications or software to enhance the SaaS-based service software using the APIs.

Aids of SaaS

The main advantage of the model is reduced costs. There is no upfront cost for installing sensors and servers and also no cost to maintain their database; the cost for sustaining them also goes to zero. All we have to pay for is the service they use to their provider. It is an anytime, ready-to-use software service, so the users only pay for the service they use and nothing more.

It offers high amounts of scalability and integration options. As the SaaS system is cloud-based, it is very easy to enhance its scale and integrate with other software as a Service application, offering the users an extreme amount of flexibility.

Drawbacks of Software as a Service (SaaS)

Security is the primary concern for the users who use SaaS-based applications; as the servers and databases are centralized, the users' data can be leaked and used for malicious activities. For this, the users are recommended to go for known service providers for choosing their third-party vendor.

The subsequent problem faced while using this type of architecture is that it can low perform quite frequently; as an application is browser-based and is running on remote servers, it takes longer for the request to fetch the required data and perform the required computing (as in the case for HPC – high-performance computing).

Software-as–a-Service (SaaS) model allows to provide software application as a service to the end users. It refers to a software that is deployed on a host service and is accessible via Internet. There are several SaaS applications listed below:

- Billing and invoicing system
- Customer Relationship Management (CRM) applications
- Help desk applications
- Human Resource (HR) solutions

Some of the SaaS applications are not customizable such as Microsoft Office Suite. But SaaS provides us Application Programming Interface (API), which allows the developer to develop a customized application.

Characteristics

Here are the characteristics of SaaS service model:

- SaaS makes the software available over the Internet.
- The software applications are maintained by the vendor.
- The license to the software may be subscription based or usage based. And it is billed on recurring basis.
- SaaS applications are cost-effective since they do not require any maintenance at end user side.
- They are available on demand.
- They can be scaled up or down on demand.
- They are automatically upgraded and updated.
- SaaS offers shared data model. Therefore, multiple users can share single instance of infrastructure. It is not required to hard code the functionality for individual users.
- All users run the same version of the software.

Benefits

Using SaaS has proved to be beneficial in terms of scalability, efficiency and performance. Some of the benefits are listed below:

- Modest software tools
- Efficient use of software licenses
- Centralized management and data
- Platform responsibilities managed by provider
- Multitenant solutions

Modest software tools

The SaaS application deployment requires a little or no client side software installation, which results in the following benefits:

- No requirement for complex software packages at client side
- Little or no risk of configuration at client side
- Low distribution cost

Efficient use of software licenses

The customer can have single license for multiple computers running at different locations which reduces the licensing cost. Also, there is no requirement for license servers because the software runs in the provider's infrastructure.

Centralized management and data

The cloud provider stores data centrally. However, the cloud providers may store data in a decentralized manner for the sake of redundancy and reliability.

Platform responsibilities managed by providers

All platform responsibilities such as backups, system maintenance, security, hardware refresh, power management, etc. are performed by the cloud provider. The customer does not need to bother about them.

Multitenant solutions

Multitenant solutions allow multiple users to share single instance of different resources in virtual isolation. Customers can customize their application without affecting the core functionality.

Issues

There are several issues associated with SaaS, some of them are listed below:

- Browser based risks
- Network dependence
- Lack of portability between SaaS clouds

Browser based risks

If the customer visits malicious website and browser becomes infected, the subsequent access to SaaS application might compromise the customer's data.

To avoid such risks, the customer can use multiple browsers and dedicate a specific browser to access SaaS applications or can use virtual desktop while accessing the SaaS applications.

Network dependence

The SaaS application can be delivered only when network is continuously available. Also network should be reliable but the network reliability cannot be guaranteed either by cloud provider or by the customer.

Lack of portability between SaaS clouds

Transferring workloads from one SaaS cloud to another is not so easy because work flow, business logics, user interfaces, support scripts can be provider specific.

Open SaaS and SOA

Open SaaS uses those SaaS applications, which are developed using open source programming language. These SaaS applications can run on any open source operating system and database. Open SaaS has several benefits listed below:

- No License Required
- Low Deployment Cost
- Less Vendor Lock-in
- More portable applications
- More Robust Solution

The following diagram shows the SaaS implementation based on SOA:
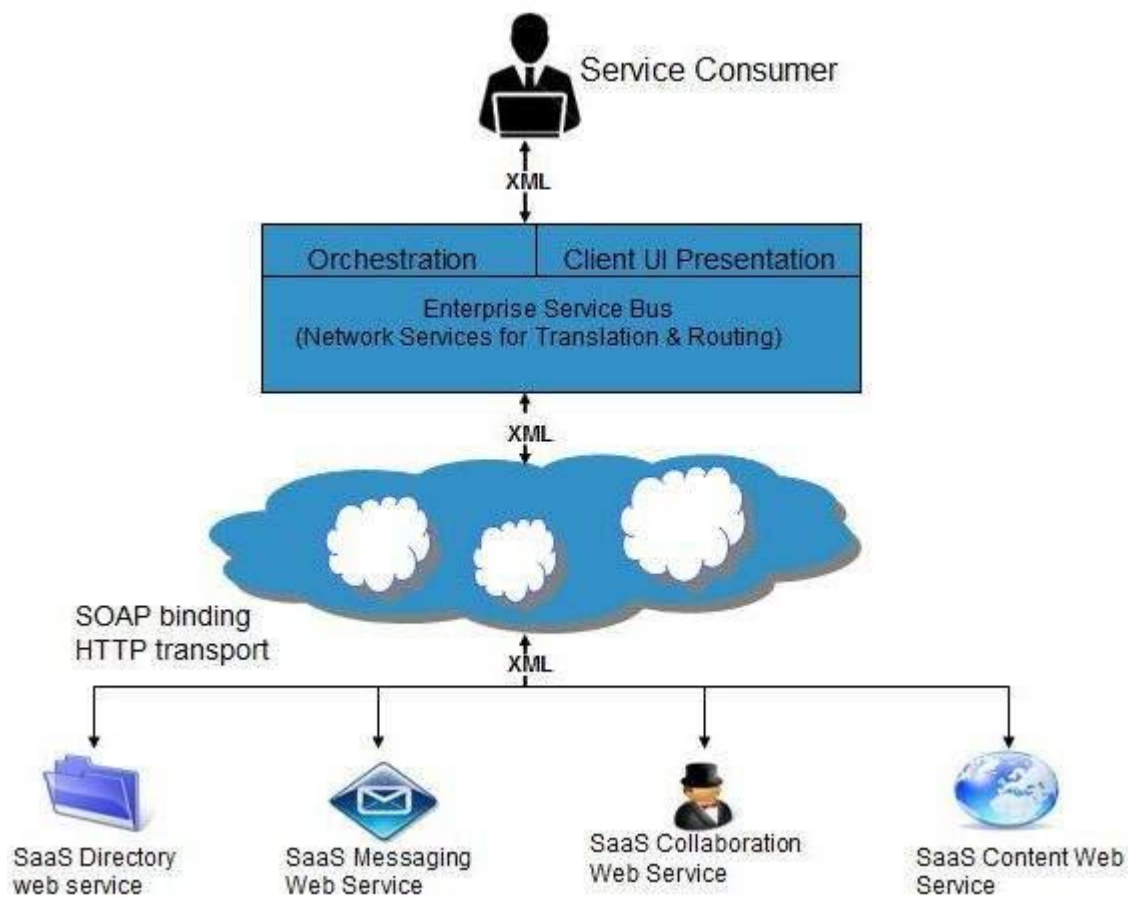

1, Platform as a services

Platform-as-a-Service offers the runtime environment for applications. It also offers development and deployment tools required to develop applications. PaaS has a feature of point-and-click tools that enables non-developers to create web applications.

App Engine of Google and Force.com are examples of PaaS offering vendors. Developer may log on to these websites and use the built-in API to create web-based applications.

But the disadvantage of using PaaS is that, the developer locks-in with a particular vendor. For example, an application written in Python against API of Google, and using App Engine of Google is likely to work only in that environment.

The following diagram shows how PaaS offers an API and development tools to the developers and how it helps the end user to access business applications.
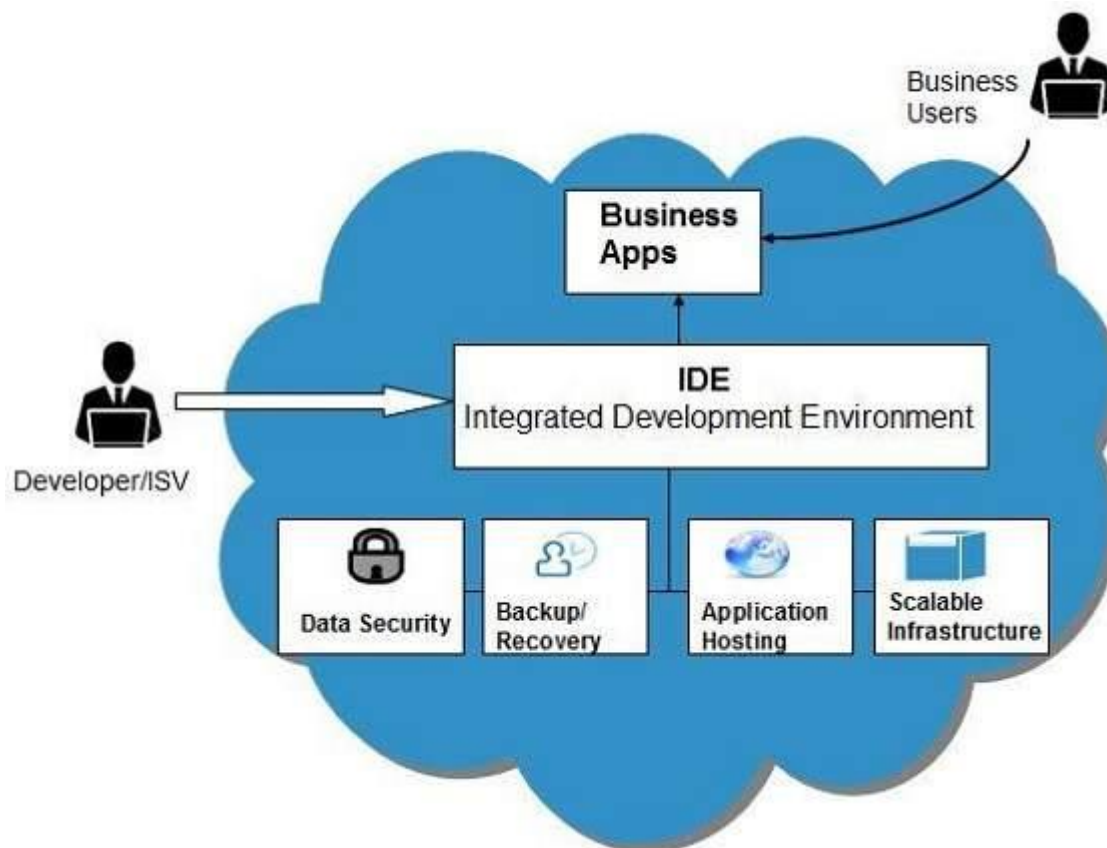
Benefits

Following are the benefits of PaaS model:
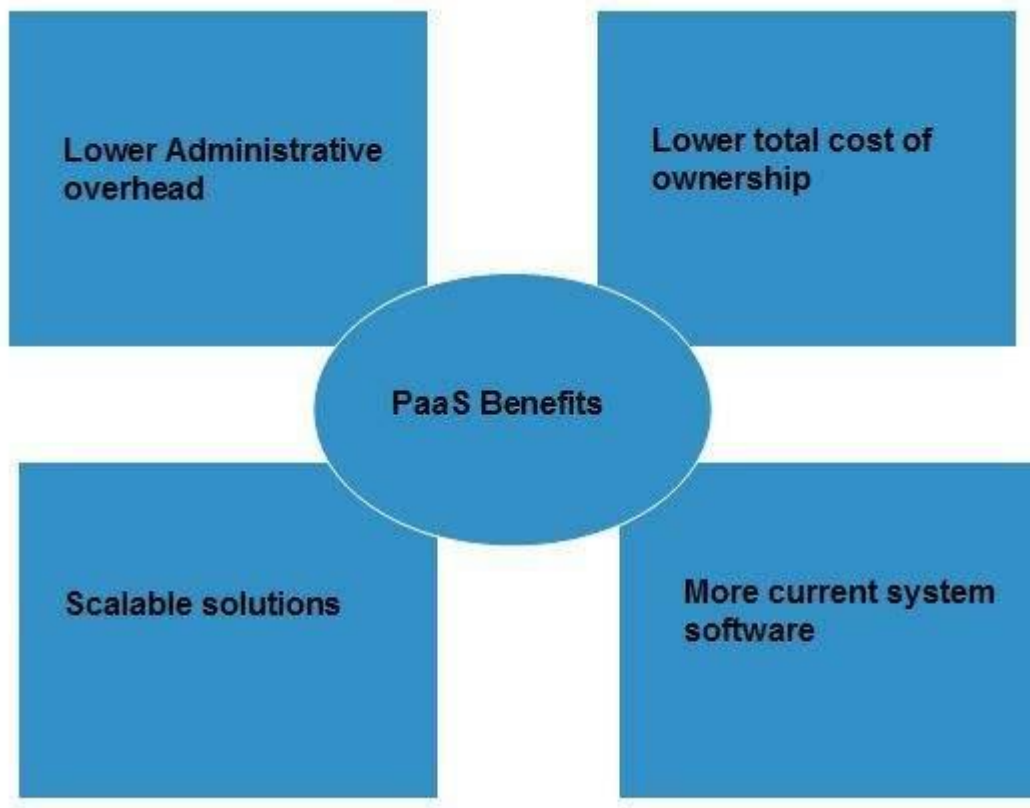
Lower administrative overhead

Customer need not bother about the administration because it is the responsibility of cloud provider.

Lower total cost of ownership

Customer need not purchase expensive hardware, servers, power, and data storage.

Scalable solutions

It is very easy to scale the resources up or down automatically, based on their demand.

More current system software

It is the responsibility of the cloud provider to maintain software versions and patch installations.

Issues

Like SaaS, PaaS also places significant burdens on customer's browsers to maintain reliable and secure connections to the provider's systems. Therefore, PaaS shares many of the issues of SaaS. However, there are some specific issues associated with PaaS as shown in the following diagram:
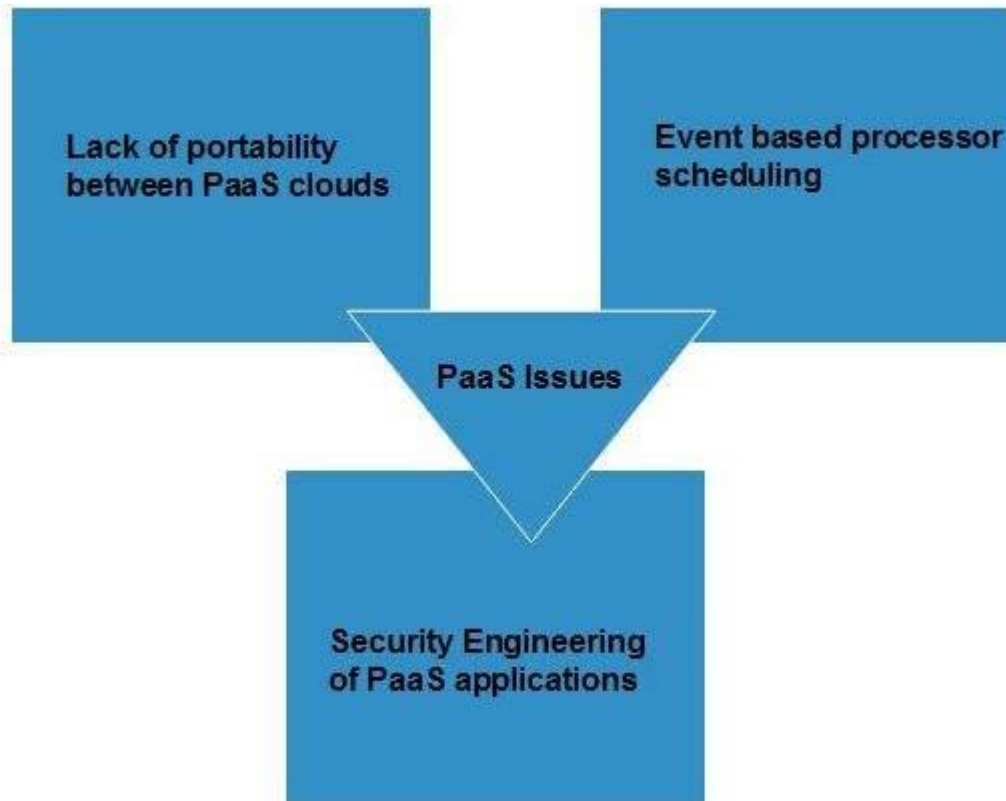
Lack of portability between PaaS clouds

Although standard languages are used, yet the implementations of platform services may vary. For example, file, queue, or hash table interfaces of one platform may differ from another, making it difficult to transfer the workloads from one platform to another.

Event based processor scheduling

The PaaS applications are event-oriented which poses resource constraints on applications, i.e., they have to answer a request in a given interval of time.

Security engineering of PaaS applications

Since PaaS applications are dependent on network, they must explicitly use cryptography and manage security exposures.

Characteristics

Here are the characteristics of PaaS service model:

- PaaS offers browser based development environment. It allows the developer to create database and edit the application code either via Application Programming Interface or point-and-click tools.
- PaaS provides built-in security, scalability, and web service interfaces.

- PaaS provides built-in tools for defining workflow, approval processes, and business rules.
- It is easy to integrate PaaS with other applications on the same platform.
- PaaS also provides web services interfaces that allow us to connect the applications outside the platform.

PaaS Types

- Based on the functions, PaaS can be classified into four types as shown in the following diagram:
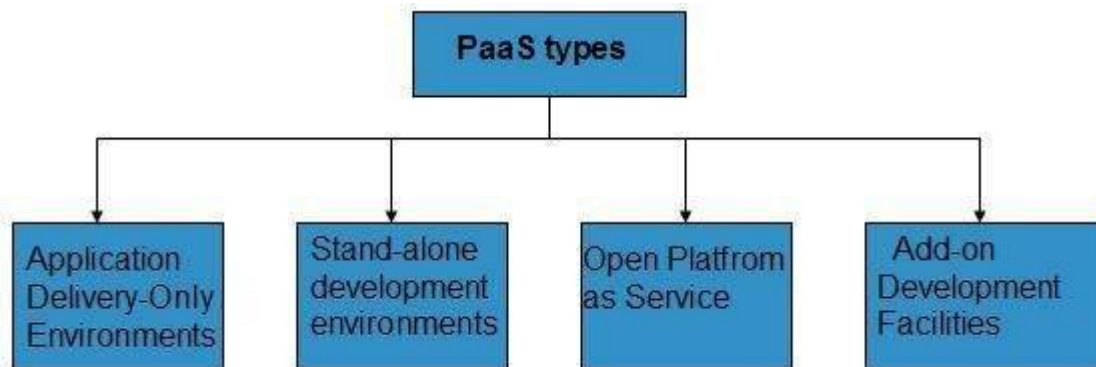
Stand-alone development environments

The stand-alone PaaS works as an independent entity for a specific function. It does not include licensing or technical dependencies on specific SaaS applications.

Application delivery-only environments

The application delivery PaaS includes on-demand scaling and application security.

Open platform as a service

Open PaaS offers an open source software that helps a PaaS provider to run applications.

Add-on development facilities

The add-on PaaS allows to customize the existing SaaS platform.

1.5 Infrastructure-as-a-Service provides access to fundamental resources such as physical machines, virtual machines, virtual storage, etc. Apart from these resources, the IaaS also offers:

- Virtual machine disk storage
- Virtual local area network (VLANs)
- Load balancers
- IP addresses
- Software bundles

All of the above resources are made available to end user via server virtualization. Moreover, these resources are accessed by the customers as if they own them.
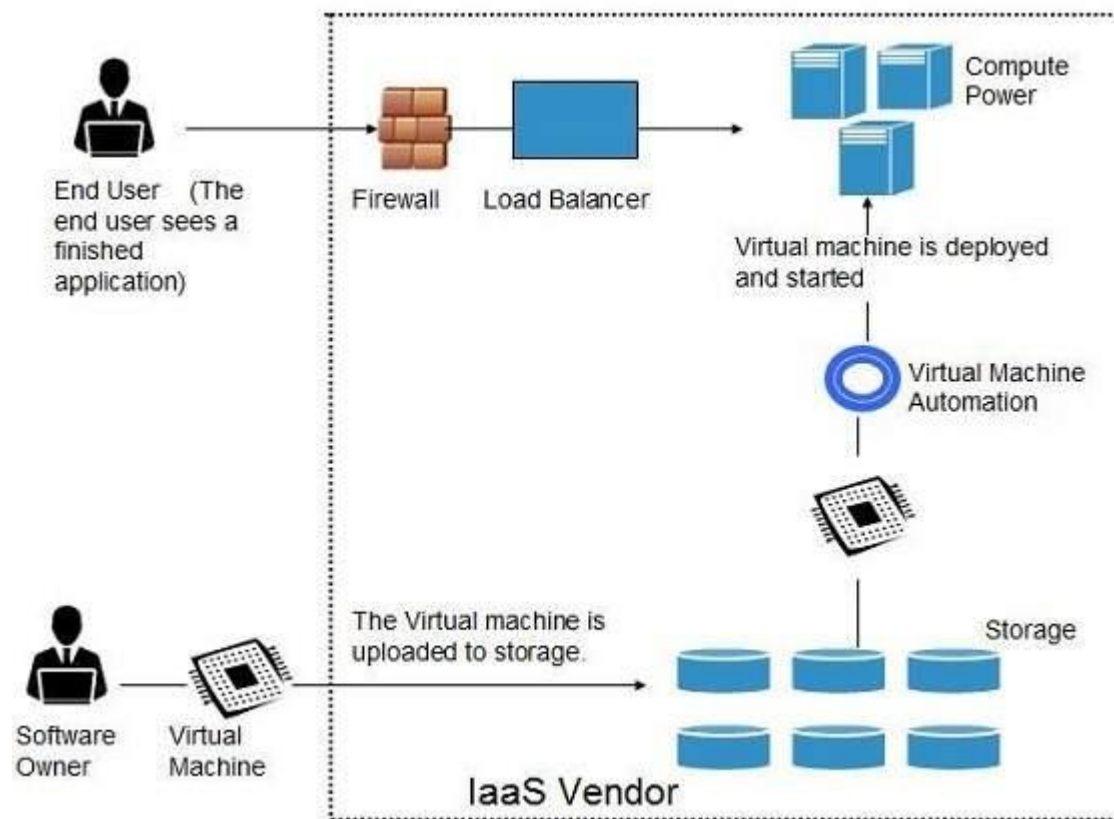
Benefits

IaaS allows the cloud provider to freely locate the infrastructure over the Internet in a cost-effective manner. Some of the key benefits of IaaS are listed below:

- **Full control of the computing resources through administrative access to VMs.**
- **Flexible and efficient renting of computer hardware.**
- **Portability, interoperability with legacy applications**.

Full control of the computing resources through administrative access to VMs

- IaaS allows the customer to access computing resources through administrative access to virtual machines in the following manner:
- Customer issues administrative command to cloud provider to run the virtual machine or to save data on cloud server.
- Customer issues administrative command to virtual machines they owned to start web server or to install new applications.

**Flexible and efficient renting of computer hardware**

- IaaS resources such as virtual machines, storage devices, bandwidth, IP addresses, monitoring services, firewalls, etc. are made available to the customers on rent. The payment is based upon the amount of time the customer retains a resource. Also with administrative access to virtual machines, the customer can run any software, even a custom operating system.

Portability, interoperability with legacy applications

- It is possible to maintain legacy between applications and workloads between IaaS clouds. For example, network applications such as web server or e-mail server that normally runs on customer-owned server hardware can also run from VMs in IaaS cloud.

Issues

- IaaS shares issues with PaaS and SaaS, such as Network dependence and browser based risks. It also has some specific issues, which are mentioned in the following diagram:
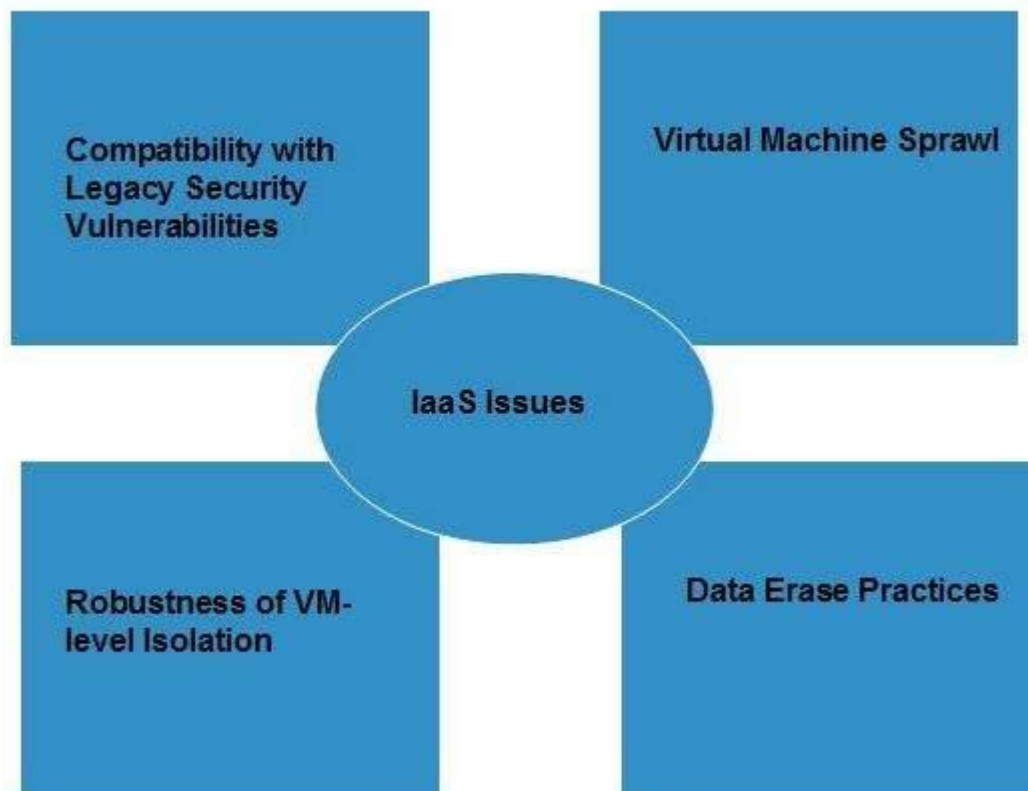
Compatibility with legacy security vulnerabilities

Because IaaS offers the customer to run legacy software in provider's infrastructure, it exposes customers to all of the security vulnerabilities of such legacy software.

Virtual Machine sprawl

The VM can become out-of-date with respect to security updates because IaaS allows the customer to operate the virtual machines in running, suspended and off state. However, the provider can automatically update such VMs, but this mechanism is hard and complex.

Robustness of VM-level isolation

IaaS offers an isolated environment to individual customers through hypervisor. Hypervisor is a software layer that includes hardware support for virtualization to split a physical computer into multiple virtual machines.

Data erase practices

The customer uses virtual machines that in turn use the common disk resources provided by the cloud provider. When the customer releases the resource, the cloud provider must ensure that next customer to rent the resource does not observe data residue from previous customer.

Characteristics

Here are the characteristics of IaaS service model:

- Virtual machines with pre-installed software.
- Virtual machines with pre-installed operating systems such as Windows, Linux, and Solaris.
- On-demand availability of resources.
- Allows to store copies of particular data at different locations.
- The computing resources can be easily scaled up and down.

1.6 Database as a services

cloud computing we can consider DBaaS (also known as Managed Database Service) as a cloud computing service. It allows users associated with database activities to access and use a cloud database system without purchasing it.

DBaaS and cloud database comes under Software as a Service (SaaS) whose demand is growing so fast

In simple we can say Database as a Service (DBaaS) is self service/ on demand database consumption coupled with automation of operations. As we know cloud computing services are like pay per use so DBaaS also based on same payment structure like how much you will use just pay for your usage. This DBaaS provides same function as like standard traditional and relational database models. So using DBaaS, organizations can avoid data base configuration, management, upgradation and security.

DBaaS consists of an info manager element, that controls all underlying info instances via API. This API is accessible to the user through a management console, typically an online application, that the user might use to manage and assemble the info and even provision or deprovision info instances.

Key Characteristics of DBaaS :

A fully managed info service helps to line up, manage, and administer your info within the cloud and conjointly offer services for hardware provisioning and Backup.

DBaaS permits the availability of info's effortlessly to Database shoppers from numerous backgrounds and IT expertise.

Provides on demand services.

Supported the resources offered, it delivers a versatile info platform that tailors itself to the environment's current desires.

A team of consultants at your disposal, endlessly watching the Databases.

Automates info administration and watching.

Leverages existing servers and storage.

How does DBaaS work ?

It is a service that is added to our databases which make our daily tasks easier. It eliminates tedious and time-consuming administration tasks and makes our tasks simpler and more flexible. Now most of the organizations are going for DBaaS as it helps organizations to accelerate their business performance by starting their working with database more easily and running the workloads without delay.

Once we move our database to the cloud, we have the option to add software deployment as a service. Doing so simplifies the processes required to make information available through Internet-based communications. Storage consolidation can also be useful for moving company databases to the cloud.

Advantages of DBaaS :

DBaaS is responsible of the info supplier to manage and maintain info hardware and code.
The hefty power bills for ventilation and cooling bills to stay the servers running area unit eliminated.
An organization that subscribes to DBaaS is free from hiring info developers or constructing a info system in-house.
Make use of the most recent automation, straightforward outs of clouds area unit possible at low price and fewer time.
Human resources needed to manage the upkeep of the system is eliminated.
Since DBaaS is hosted off-site, the organization is free from the hassles of power or network failure.
Explore the portfolio of Oracle info as a service.

Disadvantages of DBaaS :

Traditional enterprises may have objections to cloud-based services generally.
In case of significant failure of the DBaaS server or network, the organization might lose its knowledge.
Companies already equipped with resources and IT-related human resources might not realize DBaaS solutions economically viable.
Intrinsic network connected problems with cloud can impact the performance of a DBaaS.
Features offered within the typical RDBMS might not perpetually be offered during a DBaaS system.
The use of DBaaS may result in revenue loss in alternative areas of code updates and hardware management.

1.7 What is Monitoring as a Service (MaaS)?

Monitoring as a Service (MaaS) provides you with the security solutions that are essential for the organizations that are reliant on the IT infrastructure. However, for effective and efficient monitoring, the organization must have up to date technology, experts knowing advanced technical skills, scalable security processes and all this come with a tremendous expense.

Prior to the advent of electronic gadgets that are used for providing security services, the human resource was used to perform all these monitoring activities but it was ineffective.

MaaS provides an effective solution to this problem. It provides 24/7 real-time monitoring, reports any issue across the security infrastructure and secures the crucial data of their customers.

If compared to the traditional security operations centre MaaS exceed in two important things:

1. The total cost of ownership was higher in the traditional security operations centre.
2. Traditional security operations are less effective.

Features of MaaS

1. Protection Against External and Internal Threats
The security monitoring services analyze the alerts from security devices 24/7 in real-time. The security analyst collects data from various security devices to recognize the threats and thereby imply effective measures to respond to these threats.

- ### 2 Early Detection
  The information security team detects and discloses the security threats as soon after they appear. The threats are reported to the customer via emails.
  This reports describes the vulnerabilities in the security of the system and also describes its effect on the systems or application. The report may also include the protective measures that you can take for these vulnerabilities.

- ### 3 Dashboard Interface
  The dashboard interface is implemented as a platform, control and service monitoring. This conceptualizes your system and its resource at one place and eases the information security team to monitor the operation status of the platform being monitor. The information security team try to find the reason of vulnerability by navigating back in time and visualize how the system was performing before the problem occurred and how it is performing after the problem has occurred.
  As the root cause of the vulnerability is understood the preventive measure are suggested to resolve the issue.

- ### 4 Log Centralization and Analysis
  It is a monitoring solution which involves the correlation of log entries and matching of the log entries. Analyzing this correlation and matching of log entries set a benchmark for the operational performance and provide an index of the security threats.
  An alarm is raised if an incident moves above the benchmark parameters. This alarm or warning is analyzed by security experts responsible for the quick response for such threat incidents.

- ### 5 Vulnerabilities Detection and Management
  This service provides periodic automated testing which exposes the threat to information system over the internet.

The service identifies threats such as unauthorized access to the administrative services, the services that have not been updated for a long.

- **6 Continuous System Patching/Upgrade and Fortification**
  The level of security is enhanced with the continuous system patching. System patching is nothing but enhancing the computer program to fix the vulnerabilities and bugs in the computer program.
  System patching is very important as it not only raises the security level of your system but also supports the newer version of the application and software installed on your system.

- **7 Intervention, Forensics, and Help Desk Services**
  We all are familiar with the help desk that provides you with quick assistance to your problems. Similarly, the MaaS vendor has a team of experts with ample of knowledge that intervenes whenever any threat is detected. They provide 24/7 assistance to support and maintain the applications and infrastructure.
  Whenever a threat is detected it requires the forensic analysis to check out how much time cost and effort it will require to fix it.

2. Delivering Business Values

Most of the customer consider build-vs-buy decision is better if compared to calculating return on investment (ROI).
But when calculated it is observed that cost of building a security monitoring infrastructure along with the security monitoring team is more as compared to the outsourcing a MaaS service provider.

The MaaS vendors have a complete information security infrastructure along with a team of skill and the expert individual who are updated with the latest technology. The MaaS vendors provide the scalable services which is an advantage for their customers. If the company try and built its own security infrastructure it must have to focus on the staff attrition, technical updates, scheduling operations, identifying the vulnerabilities and also find the solution to resolve them. Outsourcing the MaaS services eliminates all these headaches.

Well if you want to evaluate the loss incurred by the external or internal incident the parameters that you must take into account are the amount of loss occurred, frequency of loss incurred and estimate the probability of occurring the loss. This is not an actual method to calculate the loss incurred but it helps you in tracking the security metric.

While outsourcing any service you must consider and quantify the risk involved in it. It will raise your confidence that your investment will succeed. A scalable service is more valuable as the customers can get additional business benefit by giving some additional cost.

3. Real-Time Log Monitoring Enables Compliance

Log monitoring is a process of recording log messages into a file which helps the developers or administrator to understand how the system or application is being used. Real-time log monitoring helps in quick detection of errors, failed process and services.

It also provides alerts for network and protocol failures. It warns the developers of infrastructure problems. MaaS provides automation for this time-consuming process.
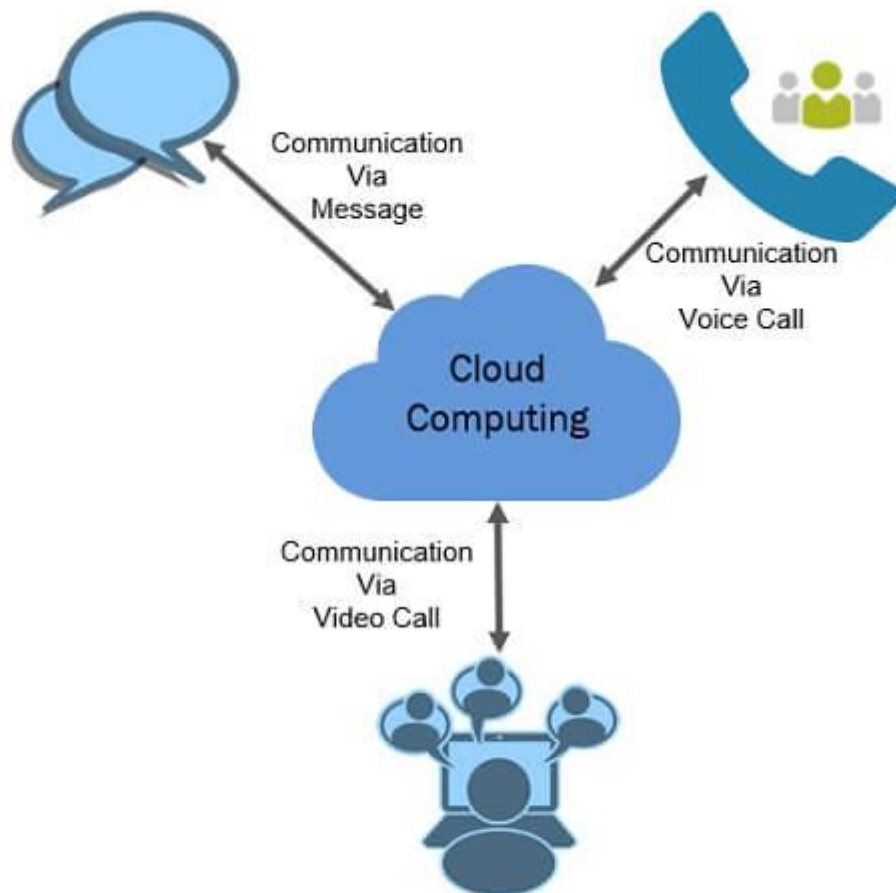
Advantages of MaaS

1. MaaS provide a ready to use a monitoring tool to its customer at a very minimal price.
2. MaaS leverage the customer to focus on their business instead of worrying about the information security of their enterprise.
3. MaaS provides 24/7 assistance to its customers, who can report the issues and get immediate assistance from the MaaS team.

1.8 Communication as a Services

Communication as a Service (CaaS) is a trending service provided to the customers by CaaS vendors that is implemented over **cloud computing technology**. Nowadays communication has become the most crucial aspect of businesses. A complete communication solution can help the business grow fast. In this content, we will discuss CaaS, its features, how does it work, the risk involved and it's advantages.

What is Communication as a Service (CaaS)?

Communication as a service (CaaS) is a cloud-based solution provided by cloud vendors. CaaS is a specialized variation of Software as a Service (SaaS) which is among three basic services delivered by the cloud computing technology. When we talk about communication, recall, in how many ways we can communicate with others. Well, we can communicate via text message, voice call and video call

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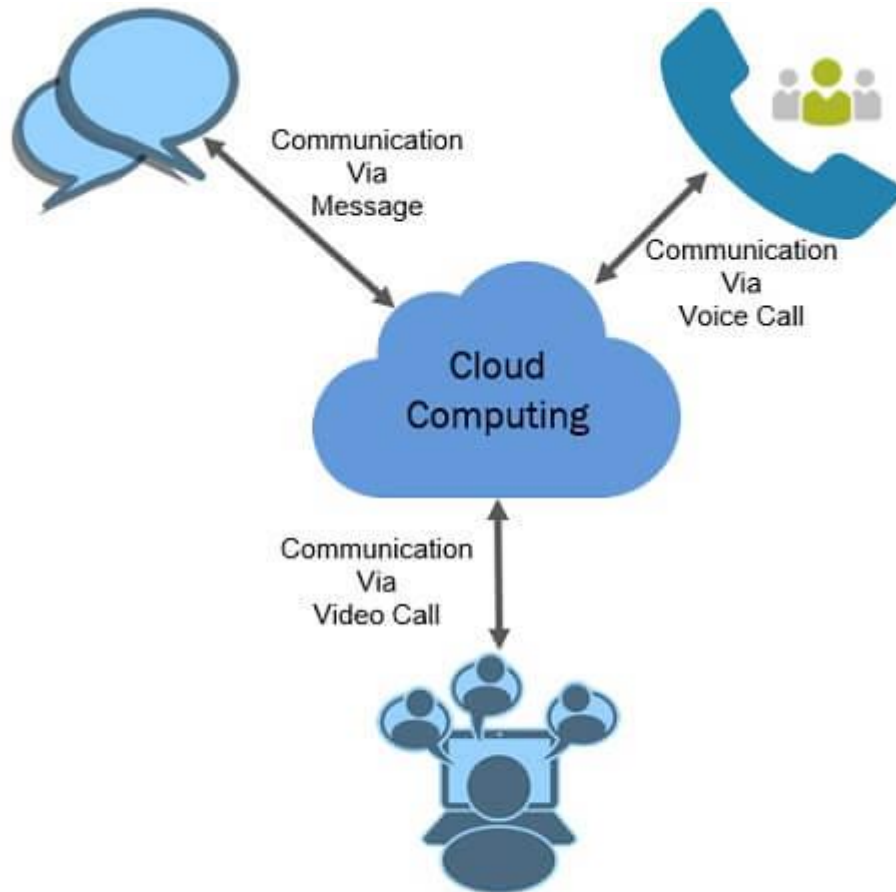
Communication as a Service (CaaS) in Cloud Computing

CaaS providers manage the hardware and software that are important for delivering Voice over IP (VoIP) for voice communication service, and other services like Instant Messaging (IM) to provide text communication service and video conferencing to provide video communication service.

CaaS model provides economical services as the service users do not have to bear the expenditure of buying and managing the communication equipment. CaaS is favourable for small IT companies that on the verge of expansion. Let us discuss the features of CaaS.

Features of CaaS

1. Integrated and Unified Communication

The advanced unified communication features include Chat, Multimedia conferencing, Microsoft Outlook integration, Real-time presence, "Soft" phones (software-based telephones), Video calls, Unified messaging and mobility.

Nowadays, CaaS vendor introduces new features to their CaaS services much faster than ever before. It has become economical for providers to introduce a new feature to their CaaS application faster because the end-users are benefitting from the provider's scalable platform infrastructure and ultimately the many end-users using the provider's service shares this cost of enhancement

2. No Investment Required
As we have learnt above it is the sole responsibility of CaaS vendor to manage hardware and software deployed to provide the communication service to their customers. The customer only has to pay for the service he is getting from the CaaS vendor, not for communication features deployed to provide communication services.

3. Flexibility & Scalability
The customer can outsource the communication services form CaaS vendors. The customers pay for what they have demanded. The customer can extend their service requirement according to their need. This brings flexibility and scalability in communication services and even make the service economical.

4. No Risk of Obsolescence
The CaaS vendors keep on updating their hardware and software that provide communication services to meet the changing demands of the market. So the customer using the services does not have to be worried about the service obsolescence.

5. No Maintenance Cost Incurred
The customer outsourcing the CaaS service does not have to bear the cost of maintaining the equipment deployed for providing communication services.

6. Ensure Business Continuity
If due to any calamity your business's geographical region is affected then how long can you continue your business? That's why nowadays companies distribute their data to the geographically dispersed data centre which maintain the redundancy & help them in recovering soon after any catastrophic event.

The same feature is adopted and implemented by the CaaS providers in order to provide voice continuity or communication continuity even if any catastrophic event strikes.

How Communication as a Service (CaaS) Works?

Business users opting for CaaS can selectively deploy communication features (hardware and software) throughout there office on a pay-as-you-go basis. CaaS vendor designs comprehensive, flexible and easy to understand service plans for their users.

The quality of communication service is assured by the CaaS vendors under the service level agreement. CaaS is a fully hosted solutions that are practised on the cloud-based technology which can be implemented over multiple types of operating system such as windows, Linus, Android & iOS. Because of this, the CaaS can be accessed through multiple types of connected devices such as mobiles, handsets, tablets, TV sets, laptop, PC etc.

CaaS has brought the revolutionary change in method of communication from person to person, person to machine and machine to machine.

CaaS abstracts the networks capability to handle peak load for their customer which make it flexible. The network capabilities can be extended to raise the network capacity, devices and area coverage based on the demands of the CaaS customers. However, the network capabilities can be extended dynamically according to customers demand so that the resources are not wasted.

Risk Involved in CaaS?

As we have mentioned earlier that the CaaS vendors are solely responsible for the quality of the service they provide. So from the customer's perspective, there is no risk involved in taking the services from the CaaS vendor.

The customers need not worry about the service being getting obsolete as the CaaS providers perform periodic updates and they also manage the replacement of hardware and software involved to keep the platform technically up to date.

Advantages of Communication as a Service (CaaS)

- CaaS provides an economical way to deliver communication service to its customer by preventing them from investing in hardware and software required for delivering communication services.
- CaaS vendor provides 24/7 service to its customers.
- Customer receiving services from CaaS vendor do not have to indulge and invest in managing the components of CaaS.
- CaaS vendor offers flexible service as they charge according to pay as you go basis.
- CaaS provide scalable services as they provide service based on customers demand.
- CaaS provides the hosted and managed solution which offers complete communication solutions managed by a single vendor only.
- From the customers perspective, there is no risk of service becoming obsolete as the vendors are responsible for upgrading the carrier platform.

CaaS is all about recognizing the use cases where this technology can be implemented to utilize the full value potential of telecommunication.

1.9 Google Cloud Platform

In advanced Cloud computing, affiliations are expected to store the entirety of their information and programming on their hard drives and servers. The more conspicuous the affiliation, the more servers they required. This method for managing treatment information isn't flexible at speed. By and by, cloud movement recommends that affiliations can scale and change at **speed and scale, accelerate** progress, drive business, smooth out works out, and decline costs. Distributed computing is basic in light of the fact that it offers flexibility, information recuperation, in every practical sense, zero upkeep, fundamental access, and a more raised level of prosperity.

The GCP is a stage that conveys north of 90 data innovation administrations (otherwise known as items), which organizations, IT experts, and engineers can use to work all the more proficiently, acquire adaptability, and empower an upper hand.

Google Cloud is a set-up of public cloud computing associations presented by Google.

The stage solidifies a degree of work with associations for joining up, putting away, and improving the unforeseen spike famous of Google equipment.

Google Cloud includes a ton of veritable resources, for example, PCs and hard plate drives, and virtual assets, such as virtual machines (VMs), that are contained in Google's waiter and develop from one side of the world to another.

Every server farm district is in a region.

Advanced change is more than "lifting and moving" old IT frameworks to the cloud for cost-saving and comfort. Genuine change traverses the whole business and empowers each individual to change.

It profoundly sees the present innovation prerequisites and the need to advance persistently. That is why associations assemble their change cloud and settle their greatest difficulties with Google Cloud.

Perhaps the greatest thing separating Google Cloud facilitating from various players is their worldwide organization.

It's effectively one of the greatest on the planet, equaling Microsoft's and Amazon's worldwide framework.

Contrasting the worldwide framework of the best three cloud suppliers is no simple errand.

Benefits and Drawbacks

As a newbie to the cloud market, GCP normally offers a more restricted scope of administrations and doesn't order a similar worldwide spread of server farms presented by AWS and Purplish blue.

Be that as it may, it gives clients profoundly specific help in three standards: enormous information, AI, and examination, with great scope and stable burden adjusting, as well as those broadly low reaction times.

Google's compartment offering greatly benefits clients as it fostered the Kubernetes standard presently used by contenders AWS and Sky blue.

Clients will generally pick GCP as an optional seller in a mixture arrangement; however, turning out to be progressively famous with associations that are immediate contenders with Amazon and hence can't utilize AWS.

It's essential to note that GCP is extremely open-source and DevOps-driven, and accordingly doesn't incorporate with Microsoft Sky blue.

Benefits

- Great joining with other Google administrations
- Quick I/O

- Solid information examination and capacity
- Works with a simple coordinated effort
- Intended for cloud-local business
- Great movability and open-source joining

Drawbacks

- The larger part of parts because of Google exclusive tech, no genuine command over Virtual Machines
- The restricted decision of programming dialects
- The intricate progress away from the stage to another merchant
- Less elements/administrations
- Less worldwide server farms

GCP Services

Google offers a seven wide variety of Administrations −

- Compute
- Management and Developer Tools
- Networking
- Identity & Security
- Storage and Databases
- Cloud artificial intelligence
- Big Data

Compute − GCP gives a versatile scope of figuring choices you can design per your requirements. It gives exceptionally versatile virtual machines. Furthermore, the choice to convey your code straightforwardly or utilize compartments.

- Google App Engine
- Google Cloud Container Registry
- Google Compute Engine
- Google Kubernetes Engine

Management Tools − The Capacity area incorporates administrations connected with observing and the board; it incorporates the accompanying administrations

- Logging
- Error Reporting
- Trace
- Checking
- Cloud Control center
- Stackdriver

Developer Tools − The Capacity space incorporates administrations connected with advancement; it incorporates the accompanying administrations

- Cloud SDK
- Cloud Source Repositories
- Cloud Test Lab
- Deployment Manager

Networking − The Capacity area incorporates administrations connected with systems administration; it incorporates the accompanying administrations

- Google Virtual Private Cloud (VPC)
- Content Delivery Network
- What is Google Cloud Associate
- Google Cloud DNS
- What is Google Cloud Web Hosting
- Google Cloud Load Balancing

Identity and Security − The Capacity area incorporates administrations connected with security; it incorporates the accompanying administrations

- Cloud IAM
- Cloud Platform Security
- Cloud Resource Manager
- Cloud Security Scanner

Storage and Databases − The Capacity area incorporates administrations connected with information capacity; it incorporates the accompanying administrations

- Google Cloud storage
- Cloud Bigtable
- Google Cloud Datastore
- Cloud SQL

Cloud artificial intelligence − The Capacity space incorporates administrations connected with AI, and it incorporates the accompanying administrations

- Cloud AI
- Jobs Application Programming Interface
- Vision Application Programming Interface
- Translation Application Programming Interface
- Speech Application Programming Interface
- Normal Language Application Programming interface

Big Data − The Capacity area incorporates administrations connected with huge amounts of information; it incorporates the accompanying administrations

- Google BigQuery
- Google Cloud Pub/Sub
- Google Cloud Datalab

- Google Cloud Dataproc

1.10 Amazon Web Services

AWS stands for Amazon Web Services which uses distributed IT infrastructure to provide different IT resources on demand.

Our AWS tutorial includes all the topics such as introduction, history of aws, global infrastructure, features of aws, IAM, Storage services, Database services, etc.

What is AWS?

o AWS stands for Amazon Web Services.

o The AWS service is provided by the Amazon that uses distributed IT infrastructure to provide different IT resources available on demand. It provides different services such as infrastructure as a service (IaaS), platform as a service (PaaS) and packaged software as a service (SaaS).

o Amazon launched AWS, a cloud computing platform to allow the different organizations to take advantage of reliable IT infrastructure.

Uses of AWS

o A small manufacturing organization uses their expertise to expand their business by leaving their IT management to the AWS.

o A large enterprise spread across the globe can utilize the AWS to deliver the training to the distributed workforce.

o An architecture consulting company can use AWS to get the high-compute rendering of construction prototype.

o A media company can use the AWS to provide different types of content such as ebox or audio files to the worldwide files.

Pay-As-You-Go

Based on the concept of Pay-As-You-Go, AWS provides the services to the customers.

AWS provides services to customers when required without any prior commitment or upfront investment. Pay-As-You-Go enables the customers to procure services from AWS.

o Computing

- o Programming models
- o Database storage
- o Networking

Advantages of AWS

1) Flexibility

- o We can get more time for core business tasks due to the instant availability of new features and services in AWS.

- o It provides effortless hosting of legacy applications. AWS does not require learning new technologies and migration of applications to the AWS provides the advanced computing and efficient storage.

- o AWS also offers a choice that whether we want to run the applications and services together or not. We can also choose to run a part of the IT infrastructure in AWS and the remaining part in data centres.

2) Cost-effectiveness

AWS requires no upfront investment, long-term commitment, and minimum expense when compared to traditional IT infrastructure that requires a huge investment.

3) Scalability/Elasticity

Through AWS, autoscaling and elastic load balancing techniques are automatically scaled up or down, when demand increases or decreases respectively. AWS techniques are ideal for handling unpredictable or very high loads. Due to this reason, organizations enjoy the benefits of reduced cost and increased user satisfaction.

4) Security

- o AWS provides end-to-end security and privacy to customers.

- o AWS has a virtual infrastructure that offers optimum availability while managing full privacy and isolation of their operations.

- o Customers can expect high-level of physical security because of Amazon's several years of experience in designing, developing and maintaining large-scale IT operation centers.

- o AWS ensures the three aspects of security, i.e., Confidentiality, integrity, and availability of user's data.

1,11 IBM Cloud Services

The IBM Cloud platform combines platform as a service (PaaS) with infrastructure as a service (IaaS) to provide an integrated experience. The platform scales and supports both small development teams and organizations, and large enterprise businesses. Globally deployed across data centers around the world, the solution you build on IBM Cloud® spins up fast and performs reliably in a tested and supported environment you can trust!

IBM Cloud provides solutions that enable higher levels of compliance, security, and management, with proven architecture patterns and methods for rapid delivery for running mission-critical workloads. Available in data centers worldwide, with multizone regions in North and South America, Europe, Asia, and Australia, you are enabled to deploy locally with global scalability.

IBM Cloud offers the most open and secure public cloud for business with a next-generation hybrid cloud platform, advanced data and AI capabilities, and deep enterprise expertise across 20 industries. Solutions are available depending on your needs for working in the public cloud, on-premises, or a combination:

- With public cloud, the resources are made available to you over the public internet. It is a multi-tenant environment, and resources like hardware and infrastructure are managed by IBM®.
- **AHybrid cloud** is a combination of public and private, giving you the flexibility to move workloads between the two based on your business and technological needs. IBM uses Red

Hat OpenShift on IBM Cloud, the market-leading hybrid cloud container platform for hybrid solutions that enables you to build once and deploy anywhere. With IBM Cloud Satellite, you can create a hybrid environment that brings the scalability and on-demand flexibility of public cloud services to the applications and data that runs in your secure private cloud.

- **Support Multicloudand hybrid multicloud solutions is also available**, which makes it easy for you to work with different vendors. IBM Cloud packs are software products for hybrid clouds that enable you to develop apps once and deploy them anywhere.
- **Virtual Private cloud) is available as a public cloud service** that lets you establish your own private cloud-like computing environment on shared public cloud infrastructure. With VPC, enterprises can define and control a virtual network that is logically isolated from all other public cloud tenants, creating a private, secure place on the public cloud.

With our open source technologies, such as Kubernetes, Red Hat OpenShift, and a full range of compute options, including virtual machines, containers, bare metal, and serverless, you have the control and flexibility that's required to support workloads in your hybrid environment. You can deploy cloud-native apps while also ensuring workload portability.

Whether you need to migrate apps to the cloud, modernize your existing apps by using cloud services, ensure data resiliency against regional failure, or use new paradigms and deployment topologies to innovate and build your cloud-native apps, the platform's open architecture is built to accommodate your use case.

What's built into the platform?

As the following diagram illustrates, the IBM Cloud platform is composed of multiple components that work together to provide a consistent and dependable cloud experience.

- A robust console that serves as the front end for creating, viewing, managing your cloud resources
- An identity and access management component that securely authenticates users for both platform services and controls access to resources consistently across IBM Cloud
- A catalog that consists of hundreds of supported products
- A search and tagging mechanism for filtering and identifying your resources
- An account and billing management system that provides exact usage for pricing plans and secure credit card fraud protection

Setting up your account

If you're a developer and you're just trying out IBM Cloud, you can go straight to the catalog and browse the products that you'd like to explore. Try filtering for all Lite and Free pricing plans to test out IBM Cloud with no costs. When you're ready to get started with an environment and get apps running in production, consider setting up the basics in your account:

- Access groups for organizing users and service IDs into one entity to make assigning access a streamlined process
- Resource groups for organizing your resources to make assigning access to a set of resources quick and easy
- IAM access policies for your access groups or individual developers

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As a financial officer for your company, you might be interested in simplifying how you manage billing and usage across multiple teams and departments. With a Subscription account, you can create an IBM Cloud

enterprise

which offers centralized account management, consolidated billing, and top-down usage reporting. An enterprise consists of an enterprise account, account groups, and individual accounts.

- The enterprise account is the parent account to all other accounts in the enterprise. Billing for the entire enterprise is managed at the enterprise account level.
- Account groups provide a way to organize related accounts. And, you get a unified view of resource usage costs across all accounts that are included in an account group.
- Similar to stand-alone accounts, accounts in an enterprise contain resources and resource groups and independent access permissions.

For more information, see the Enterprise account architecture white paper and the best practices for setting up an enterprise.

IBM Cloud catalog

Discover all that IBM Cloud has to offer. From services, software, and deployable architectures ranging from containers, compute, security, data, AI, and more, find what you need to transform your business.

The available services include options for compute, storage, networking, end-to-end developer solutions for app development, testing and deployment, security management services, traditional and open source databases, and cloud-native services. The lifecycle and operations of services are the responsibility of IBM.

You can also find a number of software products, including Cloud paks Terraform-based templates, Helm charts, and Operators. The preconfigured software solutions help you build faster. And, with a simplified installation process, you can get started quickly. You manage the deployment and configuration of the software on your own compute resources.

If you're looking for more robust solutions for your enterprise business goals, IBM Cloud offers deployable architectures that use cloud automation for deploying common architectural patterns that combine one or more cloud resources that are designed for easy deployment, scalability, and modularity.

And, if you're looking for help in your journey to cloud, check out our professional services. Browse your options for scheduling a consultation with technical experts depending on your needs, such as cloud migration, creating business solutions with IBM Garage, or developing a container security solution that works for you.