



# BACHELOR OF COMPUTER APPLICATIONS

SEMESTER 6

**DCA3243**

**CLOUD COMPUTING**

## Unit 2

# Cloud Service Modeling

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## 1. INTRODUCTION

Cloud computing providers offer their services according to three fundamental models: Infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS), where IaaS is the most basic and each higher model abstracts from the details of the lower models. In this unit, we are going to discuss the three different services provided by cloud computing and the massive role of the Software as a Service model.

A model for providing all-encompassing, practical, and on-demand network access to a shared resource pool is called cloud computing. These computing resources are easily deployed quickly and released.

Two broad classifications of cloud models:

1. Service models: The types of services the cloud offers are used to categorise service models.
2. Deployment models: Depending on who will use the cloud services and how several deployment models are categorised.

### 1.1 Objectives

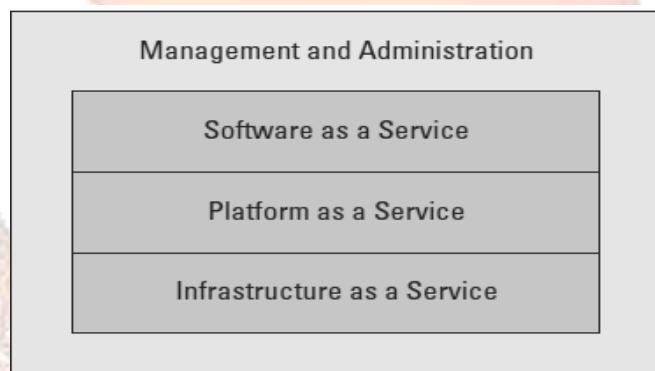
After studying this unit, you should be able to:

- ❖ Define types of cloud models
- ❖ Define service models of the cloud.
- ❖ Explain the SaaS service model of the cloud.
- ❖ Explore the PaaS service model of the cloud.
- ❖ Explore the IaaS service model of the cloud.
- ❖ Discuss the other service models.

## 2. CLOUD SERVICE MODELS

The three cloud service delivery models are Infrastructure as a Service, Platform as a Service, and Software as a Service, and the purpose of each model is as follows":

The customer accesses those services with defined interfaces. "These interfaces are, in fact, all that the user ever comes in contact with. The customer never sees the infrastructure that provides a movie on demand; for example, they only see the screen that enables the user to select and purchase the movie. Likewise, in cloud computing, the underlying infrastructure that provides the service may be very sophisticated indeed. However, the user doesn't necessarily need to understand this infrastructure to use it. Figure 1 depicts the cloud services which support management for various purposes.



**Fig 1:** Cloud service model

### SELF-ASSESSMENT QUESTIONS – 1

1. How many cloud service models are available?
2. Customer accesses the cloud services through.

### 3. INFRASTRUCTURE AS A SERVICE

Before IaaS Service Model:

- The traditional on-premises models for application development were expensive and complex and required a specific set of hardware and software specifications. Also, for every problem statement, there is a different business solution, which means a different set of hardware and software specifications. This scenario is used to force the developers to change the application every now and then.
- With the PaaS model of the cloud, application development became quick, cost-effective, and efficient.
- The main distinction between IaaS and PaaS is that although PaaS gives users more flexibility and ease of use, IaaS gives administrators more direct control over operating systems. The infrastructure for cloud-based technology is constructed by IaaS.

**Infrastructure as a Service (IaaS):** The primary objective of an organisation is to reduce the time and money required to procure, provision, and install new hardware systems. IaaS fulfils this primary objective, i.e., equipment is outsourced to support operations. This is a provision model in which the service provider is responsible for the housing, running, and maintenance of the equipment. For businesses, the greatest value of IaaS is through a concept known as cloud **bursting**, the process of offloading tasks to the cloud during times when most computer resources are needed. The potential for capital savings through cloud bursting is significant because businesses won't need to invest in additional servers that only run at 70% capacity two or three times in the year, the rest of the time sitting at 7-10% load.

Infrastructure as a Service (IaaS) is the delivery of computer hardware (servers, networking technology, storage, and data centre space) as a service. It may also include the delivery of operating systems and virtualisation technology to manage the resources. The IaaS customer rents computing resources instead of buying and installing them in their own data centre. The service is typically paid for on a usage basis.

IaaS, or infrastructure as a service, is a type of cloud computing that offers clients basic computation, network, and storage capabilities on demand, via the internet, and on a pay-as-you-go basis.

Especially in the case of "spiky" workloads, IaaS enables end users to increase and reduce resources as needed, lowering the need for expensive, upfront capital expenditures or needless "owned" infrastructure. IaaS offers the most fundamental level of control over cloud resources, in contrast to PaaS and SaaS (even more recent computing paradigms like serverless and containers).

The common virtual elements that IaaS can provide include - Computer Hardware, Computer Networks, Internet Connectivity, Platform virtualisation environment, and Service level agreements.

Through the use of the cloud, computing devices are conveniently made virtually accessible over the internet with adaptable specs and increased performance that are tailored to the needs of the user. On virtual computers, developers can run the platforms required for their software development.

IaaS makes it very simple for customers to generate instances of the virtual machines they need. Most cloud services offered by different service providers, including virtual machine setup, can be done for free or at a low cost.

Resources are fluid and scalable in almost real-time, and they are metered by consumption. Customers have direct access to self-service interfaces, such as an API and a graphical user interface (GUI). Resources are hosted by the service provider or on-site in a customer's data centre, and they can be single-tenant or multitenant.

IaaS essentially encourages access rather than ownership. This solution offers the end user options when it comes to hosting both standard software and programs that have been developed specifically for them, as well as a generic data centre for storage.

Let us see a few important functions:

- Containers on the cloud offer this virtualisation feature.
- For effective virtualisation, a direct virtual machine needs a hypervisor to be present on its hardware above the kernel.
- Contrarily, containerisation enhances processor performance and efficiency because a hypervisor is not necessary.

- Moreover, because container size can be modified dynamically, over-provisioning is avoided.

It makes it possible for many operating systems with various configurations to operate concurrently on a physical machine. Running virtual machines on a system requires a software layer known as a virtual machine monitor (VMM) or hypervisor.

These virtual machines are typically set up on the cloud using disc images, objects, load balancers, or IP addresses that can be added dynamically.

By assigning the virtual instance a different host address each time it is deployed, the virtual machine's security is also assured.

These virtual machines have been pre-installed in data centres, which house enormous equipment pools, and the service providers charge for these virtual machines on a usage-based basis, much like a utility.

Businesses are using IaaS in a variety of ways:

- Software development
- Software testing
- Hosting websites
- Supporting web apps
- High-performance computing (HPC)
- Big data analysis

IaaS service providers:

- **Amazon Elastic Cloud Compute (EC2):** Elastic Compute Cloud is known as EC2. On the Amazon cloud platform, EC2 is a service for on-demand computing. All the services a computing device can provide you with, as well as the adaptability of a virtual environment, are collectively referred to as computing.
- **Google Compute Engine:** The Infrastructure as a Service part of Google Cloud Platform, which is built on the same worldwide infrastructure as Google's search engine, Gmail, YouTube, and other services, is called Google Compute Engine.
- **Windows Azure Virtual Machines:** One of the many on-demand, scalable computing resource types that Azure provides are virtual machines. A virtual machine is typically

the best option when you require greater control over the computing environment than what the other options have to offer.

- **IBM Smart Cloud Enterprise:** The web portal for managing your cloud instances and images is called the IBM Smart Cloud Enterprise site.
- **HP Enterprise Converged Infrastructure:** A hyperconverged infrastructure, also known as a hyperconvergence infrastructure, is an IT framework that combines networking, storage, and computing into a single system to simplify operations and minimise data centre complexity.

#### Other service models available:

1. Communication as a Service (CaaS): A single provider might be contracted to provide Communications as a Service (CaaS), an outsourced enterprise communications solution. Voice over IP (VoIP or Internet telephony), instant messaging (IM), collaboration, and videoconference programs employing fixed and mobile devices can all be used for such communications.
2. Data as a Service (DaaS): A solution provider handles all employee laptops and devices for a business customer using the Device as a Service (DaaS) model on a subscription basis. In addition to offering their clients full-service IT support and device life-cycle management, daaS providers provision and deploy laptops.
3. Mobile Backend as a Service (MBaaS): A web service called mobile backend as a service (MBaaS) aims to be a one-stop shop for backend app development. Often, this comprises push alerts, security, API administration, and data and database management.
4. Disaster recovery as a service (DRaaS): Disaster recovery as a service (DRaaS) is a cloud computing service model that enables a company to back up its data and IT infrastructure in a third-party cloud computing environment and provide all the DR orchestration, all through a SaaS solution, to regain access and functionality to IT infrastructure after a disaster.
5. Monitoring as a service (MaaS): One of the various cloud computing delivery models classified as anything as a service is monitoring. It is a framework that makes it easier to deploy monitoring features for other cloud services and apps.

**SELF-ASSESSMENT QUESTIONS – 2**

3. The greatest value of IaaS was achieved through.
4. Companies with research-intensive projects are not a fit for IaaS. State [True/False].

**4. PLATFORM AS A SERVICE**

The traditional on-premises models for application development were expensive and complex, requiring a specific set of hardware and software specifications. Also, for every problem statement, there is a different business solution, which means a different set of hardware and software specifications.

This scenario is used to force the developers to change the application every now and then. With the PaaS model of the cloud, application development became quick, cost-effective, and efficient.

PaaS provides computational resources through platforms such as Operating Systems. PaaS is built upon the principles of Infrastructure as a Service by providing an environment where applications can be built and deployed in a secure, rapid, and high-quality manner. "The business needs Information Technology to rapidly develop, deploy, and maintain new applications to remain competitive, and PaaS helps organisations in the same. PaaS eliminates hardware dependency and capacity concerns. It also provides a simplified deployment model. With Platform as a Service (PaaS), the service provider delivers more than infrastructure. It delivers what you might call a solution stack – an integrated set of software that provides everything a developer needs to build an application – for both software development and runtime.

Platform as a Service is often the most confusing classification of cloud computing because it can be difficult to identify, often being mistaken for either Infrastructure as a Service or Software as a Service. The defining factor that makes PaaS unique is that it lets developers build and deploy web applications on a hosted infrastructure. In other words, PaaS allows you to leverage the seemingly infinite computing resources of a cloud infrastructure.

The PaaS components:

- Stack - consists of all the implementation's backend parts, including servers, load balancers for databases, caching systems, and language virtual machines. Deployment Machinery - includes scripts and services for deploying the apps created online.
- User experience - consists of all front-end elements, including user interface, tailored abstraction, environmental choice, and design.

We also have:

- Middleware- The software that enables user interaction with the software is referred to as middleware. It serves as a passageway between machine operating systems and user-facing applications. Applications can comprehend user input from the keyboard or mouse thanks to middleware.
- Operating system: PaaS offers any and all operating systems that programmers require for their work and on which their apps can run. Yet, the developer need not be concerned about using the most recent System or updating it for security fixes. Thus, an essential service offered by PaaS providers is the OS.

Advantages of PaaS:

- The user does not need to be concerned about the expense of infrastructure for developing applications.
- A user can create and implement many agile apps.
- Developers do not need to understand the backend operations of the cloud platform environment.
- The best technologies can be used to create applications.
- Reduction in development time and increased productivity.

There are various PAAS providers, such as :

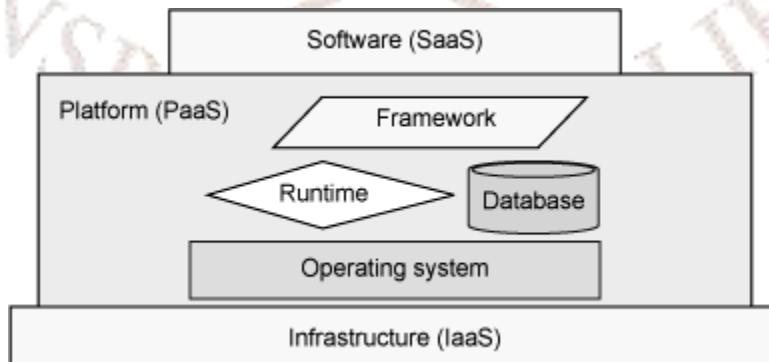
- Google App Engine by Google Cloud services from Google: A cloud computing platform as a service called Google App Engine allows users to create and host web apps in data centres under Google's control.
- Windows Azure PaaS services by Windows Azure from Microsoft: Simple cloud-based apps and large, cloud-enabled applications can both be delivered using Microsoft Azure PaaS, a deployment and development environment.

- Amazon Elastic BeanStalk by Amazon Web Services from Amazon: A service for delivering and scaling web applications and services is called Elastic Beanstalk. Elastic Beanstalk will deploy your code after you upload it, taking care of everything from capacity provisioning, load balancing, and auto-scaling to application health monitoring.
- Openshift by Red Hat from Linux: You can create, distribute, and manage container-based applications with the aid of OpenShift.
- Engine Yard runs on Amazon Web Services by Amazon- A popular platform as a service option for automating, fine-tuning, and deploying cloud applications is Engine Yard.

### The main ingredients of PaaS

Perhaps the best way to understand PaaS is to break it apart into its main components: platform and service. Now, consider the service being provided, which is referred to as a solution stack. That said, it is logical to assume that the two main ingredients of PaaS are the computing platform and the solution stack. A computing platform, in its simplest form, refers to a place where software can be launched consistently as long as the code.

Meets the standards of that platform. Common examples of platforms include Windows™, Apple Mac OS X, and Linux® for operating systems; Google Android, Windows Mobile®, and Apple iOS for mobile computing; and Adobe® AIR™ or the Microsoft® .NET Framework for software frameworks. The important thing to remember is that you're not talking about the software itself but rather the platform on which it is built to run. Figure 2 provides an illustration to help you understand this relationship.



**Fig 2.: Platform with service support**

Now that you understand the concept of platform computing let's figure out what a solution stack is. A solution stack consists of the applications that will assist in the development process as well as the deployment of the application. These applications refer to the operating system, run time environments, source control repository, and any other required middleware.

### SELF-ASSESSMENT QUESTIONS - 3

5. PaaS provides computational resources through the platform, such as \_\_\_\_\_.
6. \_\_\_\_\_ and \_\_\_\_\_ are the main components of PaaS.

## 5. SOFTWARE AS A SERVICE

SaaS is the most basic form of cloud computing. It includes the implementation of specific business functions, customised business applications, etc. The major benefit of SaaS is that there is no licensing risk involved, and there is no version compatibility issue. It reduces the hardware cost as well. You pay for the software and the underlying infrastructure and do not require technical know-how. Typical examples of SaaS application software are ERP, CRM, Google Docs, etc. SaaS ensures lower capital, better cash flow, and reduced IT support costs.

The service provider is offering the service at a much lower cost than you are providing it for yourself. If the price difference is large enough, assuming no other complications, it's a win-win – the provider grows a thriving business, and the customers pay less to run their applications.

Software as a Service provides network-based access to commercially available software. Chances are, you've already used SaaS, even if you didn't know it at the time. Examples of SaaS include Netflix, Photoshop.com, Acrobat.com, Intuit QuickBooks Online, Gmail, and Google Docs. SaaS implementations that may be somewhat less obvious include a significant portion of the growing mobile application marketplace.

SaaS represents the potential for a lower-cost way for businesses to use software – using it on demand rather than buying a license for every computer, especially when you consider

that most computers sit unused almost 70% of the time. Rather than having to buy multiple licenses for a single user, the closer a business can get to putting a license to use 100% of the time, the more money that business will save.

Traditional desktop applications have historically involved significant deployment hurdles. In fact, I've heard desktop application developers refer to updating their applications as a "deployment nightmare" on several occasions. As Tariq Ahmed states in the first chapter of *Flex 4 in Action* (Manning Press), "The logistical complications of trying to get thousands if not hundreds of thousands, of clients to run the precise version of your software at the exact same time are immense."

Ahmed goes on to say that such complications are so immense that most desktop software development companies don't even consider it reasonable or even feasible. Developers who have struggled with this in the past are good candidates for deploying SaaS versions of their software. However, the biggest barrier to entry into the SaaS marketplace that traditional software houses experience is enabling desktop applications to run as SaaS applications. In many cases, doing so involves re-writing the software on some level, which some companies find to be cost-prohibitive.

This is one of the primary reasons the movement to cloud computing has been a slow and gradual process. In most cases, the logical solution is to move the software to the cloud in phases, beginning with a highly scaled-down version of the original application provided as SaaS. This makes obvious sense when considering the level of control the developer has on version control. It's also where the specific anatomy of SaaS plays a significant role.

Examples of SaaS applications:

1. CRM: A tool known as customer relationship management (CRM) is used to handle all interactions and relationships between your business and its clients. The objective is straightforward: strengthen business ties to expand your company.
2. ERP: A form of software known as enterprise resource planning (ERP) is used by enterprises to manage routine business operations like accounting, purchasing, project management, risk management and compliance, and supply chain management. Enterprise performance management software, which aids in planning, budgeting,

forecasting, and reporting an organisation's financial results, is also a component of a full ERP suite.

3. Accounts receivable, accounts payable, sub-ledger accounting, reporting, and analytics are just a few of the daily financial activities that are managed and recorded by accounting software for a firm.

Under the SaaS business model, third parties create software and services and then make them available to enterprises via the cloud on a pay-as-you-go basis. This frees enterprises from relying on physical equipment and constrained business hours and allows them to access apps from anywhere with an Internet connection whenever they need them.

Here are a few advantages of SaaS:

- It is simple to find software to create applications, which cuts down on the time needed for application development.
- SaaS models make more apps more widely accessible.
- It results in data interoperability and uniformity throughout the company, organisation, or enterprise.
- These SaaS apps can be scaled and customised to meet the needs of the user.
- The new versions of SaaS software are maintained by SaaS providers.

Now, the business is bursting at the seams with over 6,000 marketing technology companies. The knowledge gap between customers and vendors also develops as the marketing technology landscape does.

Below are listed a few popular SaaS vendors:

For example:

**Abiquo:** A web-based cloud computing software platform called the Abiquo Hybrid Cloud Management Platform was created by Abiquo. It is used to create, integrate, and operate public and private clouds in uniform settings because it was totally written in Java. Servers, storage systems, networks, and virtual devices can all be deployed and managed by users.

**Cloud9:** Online IDE Cloud9 IDE was released as open source, starting with version 2.0 and continuing through version 3.0. C, C++, PHP, Ruby, Perl, Python, JavaScript with Node.js, and

Go are just a few of the programming languages it supports. The majority of it is written in JavaScript, while the back end is powered by Node.js.

**Salesforce.com:** An American provider of cloud-based software, Salesforce, Inc. is situated in San Francisco, California. It offers customer relationship management software and apps with an emphasis on e-commerce, analytics, customer service, sales, and customer service automation.

#### SELF-ASSESSMENT QUESTIONS – 4

7. SaaS reduces the hardware cost State [True/False]
8. The fourth driving factor of return on investment for SaaS is considered as.

## 6. MASSIVELY SCALED SOFTWARE AS A SERVICE (MS SAAS)

Massively Scaled Software as a Service (MS SaaS) is a distinct type of Software as a Service (SaaS) tailored for applications that demand immense scalability to accommodate numerous users, transactions, and data on an unprecedented scale. These applications are meticulously engineered to ensure high performance, availability, and reliability, all while serving a worldwide user base. MS SaaS's advantages include its global accessibility and potential cost efficiency. However, challenges such as intricacy and security considerations must be acknowledged. Organisations interested in MS SaaS should thoroughly assess their requirements, technical capacities, and budget prior to embarking on such an initiative.

## 7. SUMMARY

- The process of cloud assessment is very complex and encompasses many factors, none of which can be overlooked if a company wants to ensure successful cloud onboarding.
- The three cloud service delivery models are Infrastructure as a Service, Platform as a Service, and Software as a Service
- For businesses, the greatest value of IaaS is achieved through a concept known as cloud bursting.
- PaaS provides computational resources through the platform, such as the Operating System.
- SaaS is the most basic form of cloud computing. It includes the implementation of specific business functions and customised business applications.

## 8. TERMINAL QUESTIONS

1. Explain in detail the service modelling of cloud computing.
2. Explain the concept of Infrastructure as a service.
3. Discuss “Platform as a Service.”
4. Elaborate the concept of Software as a service.

## 9. ANSWERS

### Self-Assessment Questions

1. Three
2. Interfaces
3. cloud bursting.
4. False
5. operating System
6. Platform and service
7. True
8. speed of deployment

### Terminal Questions

1. Due to the list of attractive business benefits of the cloud that is only getting longer as the new ways for successful mitigation. For details, refer to Section 2
2. Infrastructure as a Service (IaaS) is the delivery of computer hardware (servers, networking technology, storage, and data centre space) as a service. For details, refer to Section 2
3. PaaS is built upon the principles of Infrastructure as a Service by providing an environment where applications can be built and deployed in a secure, rapid, and high-quality manner. For more details, refer to Section 2
4. SaaS is the most basic form of cloud computing. It includes implementing specific business functions, customised business applications, etc. For details, refer to section 2.

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