INTRODUCTION TO CLOUD COMPUTING

IBM Full Stack Cloud Developer Offered by IBM

Course overview

The course will help you to develop skills in variety of technologies including: cloud foundations, HTML, CSS, JavaScript, GitHub, Node.js, React, Cloud Native Practices, DevOps, CI/DI, containers, Dockers, Kubernetes, OpenShift, Istio, Python programming, Database, SQL, NoSQL, Django ORM, Bootstrap, Application security, microservers, serverless computing and more.

About the course

The course introduces the core concepts of cloud computing, you gain the foundation knowledge required for understanding cloud computing from a business perspective as also for becoming a cloud practitioner. You understand the definition and essential characteristics of cloud computing, its history, the business case for cloud computing, and emerging technology usecases enabled by cloud. We introduce you to some of the prominent service providers of our times (e.g. AWS, Google, IBM, Microsoft, etc.) the services they offer, and look at some case studies of cloud computing across industry verticals.

You learn about the various cloud service models (IaaS, PaaS, SaaS) and deployment models (Public, Private, Hybrid) and the key components of a cloud infrastructure (VMs, Networking, Storage - File, Block, Object, CDN). We also cover emergent cloud trends and practices including - Hybrid Multicloud, Microservices, Serverless, DevOps, Cloud Native and Application Modernization. And we go over the basics of cloud security, monitoring, and different job roles in the cloud industry.

Introduction to Cloud Computing

Today, cloud represents a huge market, one that is continuing to grow at an unprecedented scale. Enormous computational power, once considered a prerogative of large enterprises, is now available at the fingertips of even the smallest of businesses and individual developers, thanks to Cloud.

The course is designed for everyone—it doesn't matter if you have a background in cloud technologies. Whether you're an IT person looking to upskill or explore this domain, a fresh graduate looking to make a career in cloud technologies, or an IT decision-maker, this course will equip you with what you need to get started

Moreover, the Cloud makes all this computational power highly affordable with pay-as-you-go economics. If you look at some of the key emerging technologies of our times, such as Artificial Intelligence, the Internet of Things, Blockchain and Analytics, all of these technologies work with massive amounts of data and need huge storage space and computational power in order to work—making cloud possibly the only viable platform for these technologies

Course Learning Objectives

- Define cloud computing and explain its essential characteristics, evolution, and the business case for cloud adoption
- Explain how some of the emerging technologies, such as the Internet of Things, Artificial Intelligence, Blockchain, and Analytics, are being supported by the cloud
- Describe the key features, benefits, and use cases of different types of cloud service and deployment models
- Explain the concepts and components of cloud infrastructure such as virtual machines, bare metal servers, cloud networking, and container-based technologies
- Describe the features, benefits, and use cases for different types of cloud storage
- Explain how Content Delivery Networks work
- Describe the features, use cases, and benefits of emergent cloud trends such as Hybrid Multicloud, Microservices, and Serverless computing
- Explain the key concepts, development principles, use cases, and benefits of cloud native applications
- Describe how DevOps practices help tackle some of the complexities posed by the cloud
- Explain how organizations can modernize their applications
- Explain the key concepts and components of cloud security, including Identity and Access Management, and Cloud Encryption
- List the job roles and career opportunities available in cloud computing
- Create an account on IBM Cloud
- Create an object storage instance on IBM Cloud and add items to your storage

Introduction to Cloud Computing Syllabus

MODULE 1: Overview of Cloud Computing

MODULE 2: Cloud Computing Models

MODULE 3: Components of cloud computing

MODULE 4: Emergent trends & practices

MODULE 5: Cloud Security and Monitoring, Case Studies, and Jobs

Overview of Cloud Computing

- Introduction of cloud computing
- Business care for cloud computing
- Emerging technologies accelerated by cloud

MODULE 1:
Overview of Cloud Computing

INTRODUCION TO CLOUD COMPUTING

Definition and Essential Characteristics of Cloud Computing

Cloud computing, also referred to as " the cloud" is the delivery of on-demand computing resources-everything from applications to data centers over the internet on a pay-for-use basis.

To get a common understanding of cloud computing, let's start with the US National Institute of Standards and Technology (NIST'S) definition of cloud computing. NIST defines cloud computing as a model for enabling convenient, on-demand network access to a shared pool of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction.

5 ESSENTIAL CHARACTERISTICS

1. ON-DEMANF SELF SERVICES
2. BROAD NETWORK ACCESS
3. RESOURCE POOLING
4. RAPID ELASTICITY
5. MEASURED SERVICES

1.On-demand Self-service

you get access to cloud resources such as the processing power, storage, and network you need, using a simple interface, without requiring human interaction with each service provider

2.Broad Network Access

cloud computing resources can be accessed via the network through standard mechanisms and platforms such as mobile phones, tablets, laptops, and workstations

3.Resource Pooling

gives cloud providers economies of scale, which they pass on to their customers, making cloud cost-efficient. Using a multi-tenant model, computing resources are pooled to serve multiple consumers; cloud resources are dynamically assigned and reassigned, according to demand, without customers needing to concern themselves with the physical location of these resources

4.Rapid Elasticity

you can access more resources when you need them and scale back when you don't need .

5.Measured Services

you only pay for what you use or reserve as you go; if you're not using resources, you're not paying.Resource usage is monitored, measured,and reported transparently based on utilization

3 Types of Cloud Deploymennt Models

1. Public

Public cloud is when you leverage cloud services over the open internet on hardware owned by the cloud provider, but its usage is shared by other companies

3. Hybrid

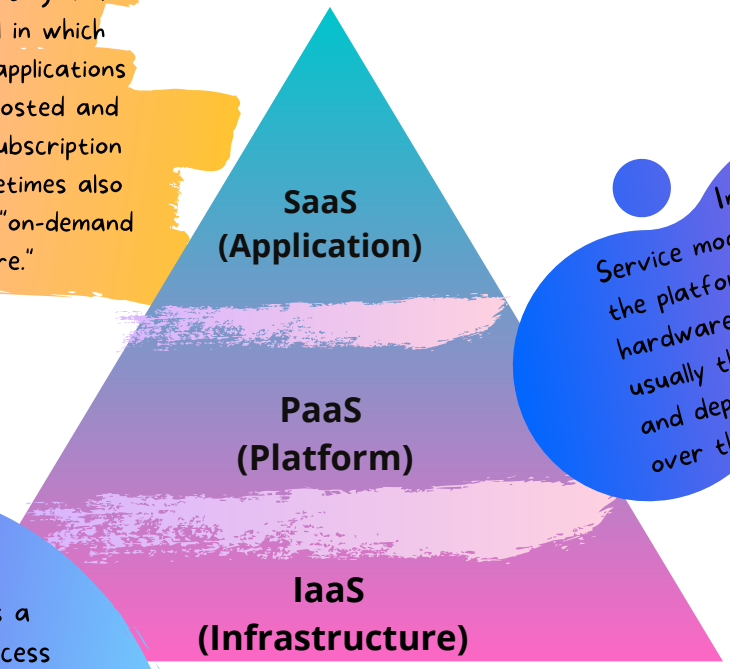
mix of both public and private clouds, working together seamlessly, that is classified as the Hybrid model

2. Private

Private cloud means that the cloud infrastructure is provisioned for exclusive use by a single organization. It could run on-premises or it could be owned, managed, and operated by a service provider.

3 Service Models

Software as a Service is a software licensing and delivery model in which software and applications are centrally hosted and licensed on a subscription basis, and sometimes also referred to as "on-demand software."



In a Platform as a Service model, you get access to the platform, that is the hardware and software tools, usually those needed to develop and deploy applications to users over the Internet.

In an Infrastructure as a Service model, you get access to infrastructure and physical computing resources such as servers, networking, storage, and data center space - without the need to manage or operate them.

History and Evolution of Cloud Computing

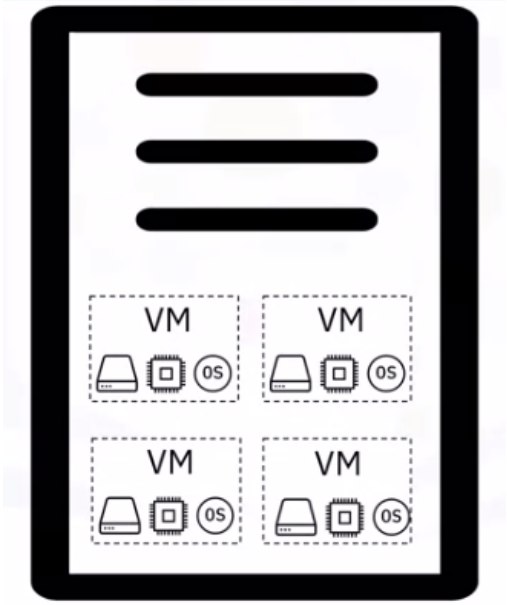
In 1950s the large-scale mainframes, with high-volume processing power became available. In order to make efficient use of the computing power of mainframes, the practice of time sharing, or resource pooling Using dumb terminals, the purpose was to facilitate access to the mainframes, multiple users were able to access the same data storage layer and CPU power from any terminal.

In 1970s Virtual machine became possible for mainframes to have multiple virtual systems, or virtual machines, on a single physical node. The virtual machine operating system evolved the 1950s application of shared access of a mainframe by allowing multiple distinct compute environments to exist on the same physical hardware

VIRTUAL MACHINES

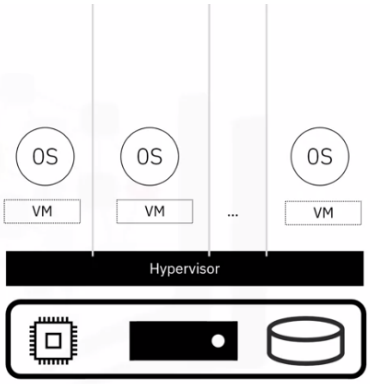
Each virtual machine hosted guest operating systems that behaved as though they had their own memory, CPU, and hard drives, even though these were shared resources.

VMs- multiple distinct compute environments on the same physical hardware



Even 20 years ago, physical hardware was quite expensive. With the internet becoming more accessible, and the need to make hardware costs more viable, servers were virtualized into shared hosting environments, virtual private servers, and virtual dedicated servers, using the same types of functionality provided by the virtual machine operating system, this was enables by hypervisors.

HYPERVISORS



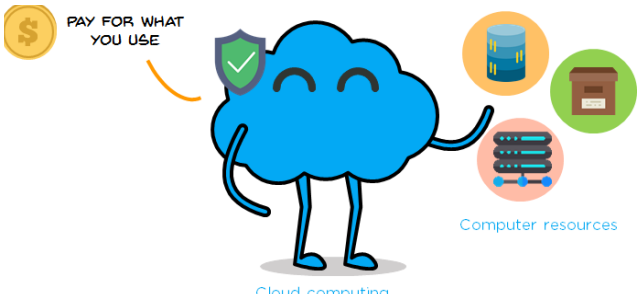
A hypervisor is a small software layer that enables multiple operating systems to run alongside each other, sharing the same physical computing resources. A hypervisor also separates the Virtual Machines logically, assigning each its own slice of the underlying computing power, memory, and storage, preventing the virtual machines from interfering with each other. So, if, for example, one operating system suffers a crash or a security compromise, the others keep working.

As technologies and hypervisors improved and were able to share and deliver resources reliably, some companies decided to make the cloud's benefits accessible to users who didn't have an abundance of physical servers to create their own cloud computing infrastructure. Since the servers were already online, the process of spinning up a new instance was instantaneous.

Users could now order cloud resources they needed from a larger pool of available resources, and they could pay for them on a per-use basis, also known as Pay-As-You-Go. This pay-as-you-go or utility computing model became one of the key drivers behind cloud computing taking off.

The pay-per-use model allowed companies and even individual developers to pay for the computing resources as and when they used them, just like units of electricity.

This allowed them to switch to a more cash-flow friendly,



This model appealed to all sizes of companies, those who had little or no hardware, and even those that had lots of hardware, because now, instead of making huge capital expenditures in hardware, they could pay for compute resources as and when needed.

It also allowed them to scale their workloads during usage peaks, and scale down when usage subsided. And this gave rise to modern-day cloud computing. The impact of the evolution of the cloud has been immense. In the next training, we will go over some key considerations for cloud adoption.

Key Considerations for Cloud Computing

Every organization's transformation journey is unique, and therefore every organization's cloud adoption strategy is also unique to them.

Agility

Flexibility

Compititiveness

Infrastructure and Workloads

- The cost of building and operating data centers can become very high.
- low initial costs and pay-as-you-go attributes of cloud computing can add up to significant cost savings than building a data centers or servers.

Organizations need to consider if paying for application access is a more viable option than purchasing off-the-shelf software and subsequently investing in upgrades

Benefits of cloud adoption

- Flexibility
- Users can scale back or scale up services to fit their needs
- Customize applications
- access cloud services from anywhere
- Virtual Private Clouds, encryption, and API keys help keep data secure. Cloud also brings great efficiency
- Bring great efficiency
- Enterprise users can get applications quickly without worrying about building infrastructure costs or its maintenance
- Cloud-based applications and data are accessible from virtually any internet-connected device.
- Hardware failures do not result in data loss because of networked backups.

Cloud computing uses remote resources, saving organizations the cost of servers and other equipment, and paying on use-basis. Cloud services give enterprises a competitive advantage by providing the most innovative technologies available while managing the underlying infrastructure, thus enabling organizations to focus on their priorities

Challenges of Cloud Adoption

- Data security, associated with loss or unavailability of data causing business disruption
- Governance and sovereignty issues
- Legal, regulatory and compliance issues
- Lack of standardization
- Choosing the right deployment and service models to serve specific needs
- partnering with right cloud service providers
- concerns related to business continuity and disaster recovery

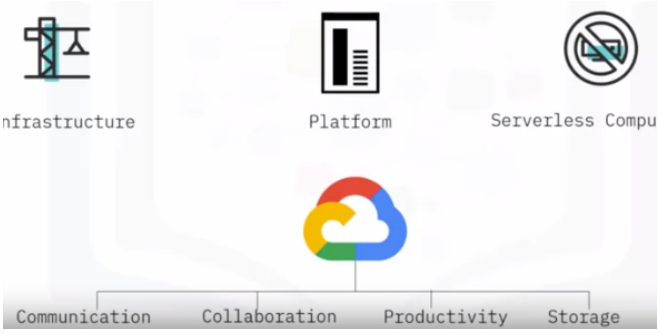
With the right cloud adoption strategies, technologies, services, and service providers, these risks can be mitigated

Key Cloud Service Providers and Their Services

amazon web services

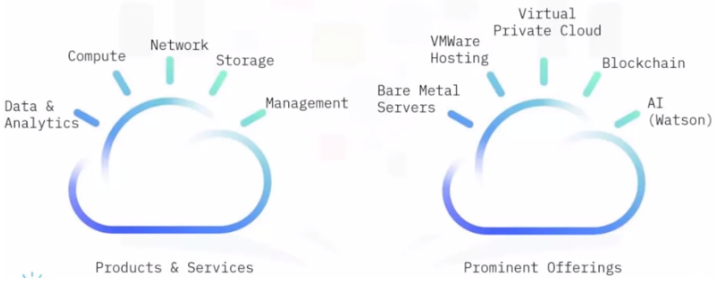
Amazon Web Services, or AWS Cloud, offers an extensive range of Infrastructure and Platform services to individuals, companies, and governments on a metered pay-as-you-go basis. The Amazon Cloud provides a wide range of products, services, and solutions ranging from Compute, DevOps, Data, Analytics, IoT, Machine Learning, Networking, Content Delivery, Robotics, Serverless Computing, and much more

Google Cloud



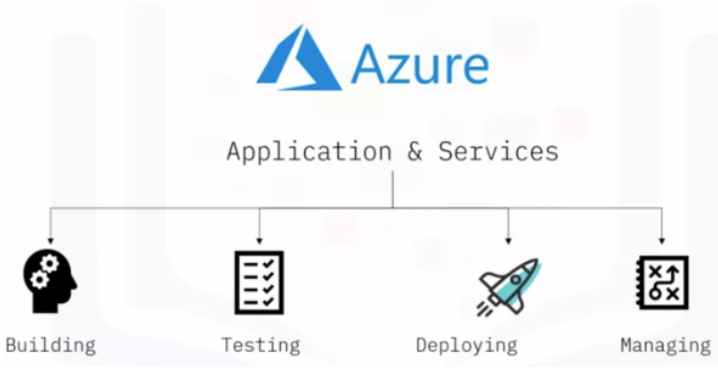
Google Cloud Platform, or GCP, is a suite of cloud computing services, providing Infrastructure, Platform, and Serverless Computing environments. Google also uses GCP internally for their end-user products such as Google Search and YouTube. Google Cloud includes G Suite with products for communication, productivity, collaboration, storage, and more. The Google App Engine is a platform for developing and hosting web applications in Google-managed data centers, automatically allocating and de-allocating resources to handle demand.

IBM cloud is a full stack cloud platform that spans public, private, and hybrid environments with products and services covering compute, network, storage, management, security, DevOps, and databases. Some of their prominent offerings include their Bare Metal Servers, VMWare, Cloud Paks for Application Modernization, Virtual Private Cloud, and the suite of emerging technologies such as AI, IoT, Blockchain, Data and Analytics. With the acquisition of Red Hat, IBM is also positioning itself as the leading hybrid cloud provider of our times.



Microsoft Azure

Microsoft Azure is a flexible cloud platform for building, testing, deploying, and managing applications and services through Microsoft-managed data centers. With its data centers spread out in many regions, Azure provides a global reach with a local presence. It provides Software, Platform, and Infrastructure services supporting Microsoft-specific and third-party languages, tools, and frameworks. Oracle Cloud is primarily known for Software as a Service and Database as a Service (also known as the Oracle Data Cloud).



INTRODUCTION OF CLOUD COMPUTING SUMMARY

- Cloud computing is the delivery of on-demand computing resources over the internet on a pay-as-you-go basis; resources are dynamically assigned and reassigned among multiple users and scale up and down in response to users' needs.
- The origins of cloud computing can be traced back to the mainframes of the 1950s, with virtualization technologies and hypervisors serving as catalysts for the emergence of modern-day cloud computing.
- Organizations must consider their business needs, investment viability, and risk capacity in order to create a cloud adoption strategy that delivers desired benefits without causing business disruptions and security, compliance, or performance issues.
- Cloud adoption is growing faster than predicted. Driving this technological wave are cloud service providers with a host of services ranging from Infrastructure, Platform, and Software services. Some major Cloud providers of our times include AWS, Alibaba Cloud, Google, IBM, and Microsoft Azure.

BUSINESS CASE FOR CLOUD COMPUTING

Cloud Adoption - No longer a choice

- From a single individual to a global multi-billion-dollar enterprise, anybody can access the computing capacity they need on the cloud.
- The lag time from decision to value is no longer a journey of years with high upfront capital; cloud makes it possible for businesses to experiment, fail, and learn much faster than ever before, with low risk exposure
- Businesses today have greater freedom to change course than to live with the consequences of expensive decisions taken in the past
- To remain competitive, businesses need to be able to respond quickly to marketplace changes, use analytics to understand customer experience, and apply that understanding to adapt their products and services based on what they learn
- Product lifecycles have shortened, and barriers to entry have become lower
- Today's enablers for growth, agility, and innovation include:Cognitively-enabled workflows, Applied exponential technologies such as AI, Automation, IoT, and Blockchain, applications that span new and legacy solutions, and open hybrid and secure Multicloud infrastructures, are today's enablers for growth, agility and innovation
- The International Data Corporation, IDC, predicts that by 2025, the total amount of digital data created worldwide will rise to 163 zettabytes (where one zettabyte is equivalent to a trillion gigabytes). And 30% of this data will be real-time information.
- Considering the unprecedented amounts of data being produced daily, and the ability to make data-driven decisions crucial to any business, cloud computing becomes essential for businesses to succeed, sustain, and compete in today's markets.
- A cloud strategy, more than just an IT strategy, is the core component of any business strategy today. Businesses that haven't already, or are not currently, integrating cloud into their business strategy, run the risk of lacking the speed, agility, innovation, and decision-making capacities needed to be competitive, as also their ability to respond to digital disruption

BUSINESS CASE FOR CLOUD COMPUTING SUMMARY:

The adoption of cloud technologies is enabling enterprises, big and small, to be agile, innovative, and competitive, and to create differentiated customer experiences. The question organizations are asking is not whether they should move to the cloud, rather what strategy they should adopt to move to the cloud.

Cloud Adoption - Some case studies

We will look at how some of the leading businesses have transformed the way they work to provide better customer service, remove barriers to innovation, achieve enterprise scale, and accelerate growth, using cloud technologies. Although the case studies we'll look at are curated from IBM Cloud, similar stories with dramatic impact to business can be found across the spectrum of companies utilizing other Cloud Service providers as well.

American Airlines

BETTER CUSTOMER SERVICE: In the highly competitive airline industry, customer experience is a major point of differentiation, and digital channels are increasingly important. To become more responsive to customer needs, American Airlines needed a new technology platform and a new approach to development that would help it deliver digital self-service tools and customer value more rapidly across its enterprise. The airline recognized the opportunity to remove the constraints of their existing customer-facing applications based on monolithic code into cloud-native based microservices architecture on the cloud. The results: Faster development and release of new apps. Improved operational reliability, productivity, and end customer response times. Cost savings by avoiding existing upgrade costs via migration to the IBM Cloud

UBank

REMOVING BARRIERS TO INNOVATION: As a lean organization with a self-imposed limit on headcount, UBank excels at finding innovative ways to meet demands. Continually challenged to find more efficient ways to operate, UBank's IT team explored a Platform as a Service (PaaS) cloud development model. Their need was to give more control to their developers, reduce the need for additional resources, faster speed to market, and removing barriers in going from an idea to production. UBank launched new initiatives in an IBM Cloud Platform environment, including a virtual assistant that incorporates IBM Watson technology to support the bank's online home loan application. The results: Faster time to market made possible through the Cloud Platform framework that streamlines development and empowers product teams. Foster greater innovation with cloud-based development resources that are quick, easy, and cost-effective to deploy. More efficient operations.

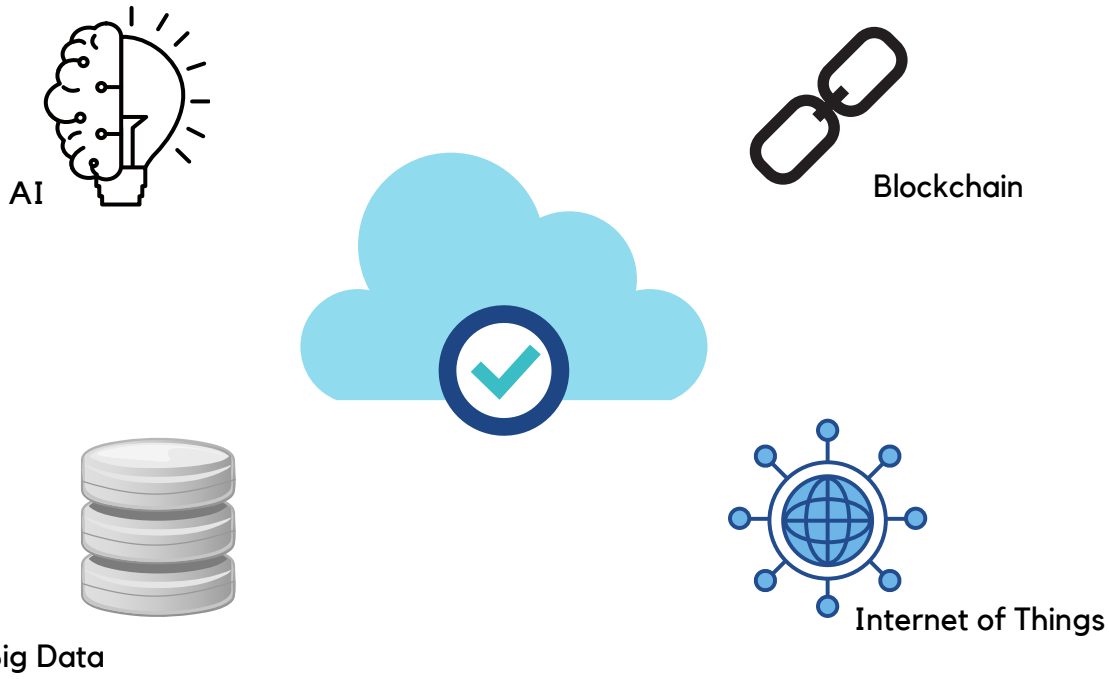
Bitly

DEMAND FOR ENTERPRISE SCALE: Since its inception in 2008, Bitly has journeyed from a startup that offered intelligent link-shortening technology adopted by users to compress lengthy URLs for social media posts, to an enterprise product. Seeking an agile, cost-effective IT infrastructure to support this transition, Bitly started planning for cloud migration. Their need was to have a cloud-based model with pay-as-you-go pricing, the ability to scale up and scale down, a more global presence, and the ability to geodistribute into more POPs. And they wanted it to be low-risk. Bitly migrated to an IBM Cloud environment, establishing a scalable hosting platform for low-latency delivery to enterprise customers around the world. The results: 25 billion data-infused links migrated from one hosting site to Cloud infrastructure with data center locations worldwide. 1 billion user interaction data set stored and managed in a flexible, cost-effective Cloud Object Storage environment. Transformed IT operations to scale for growth, control costs and focus valuable resources on new product development.

ACCELERATING GROWTH: Financial traders demand extreme speed and availability from trading systems. Profitability depends on split-second decisions. As a leading online broker in forex, commodities, equities, cryptocurrencies, indices, and other financial instruments, ActivTrades enables investors to buy and sell on numerous financial markets. Investors need reliable access to accurate market information, combined with the ability to move rapidly to execute trades. As its client base grew, ActivTrades wanted to cut latency, accelerate execution, and streamline the delivery of new functions. ActivTrades migrated three major trading systems from on-premises infrastructure to IBM Cloud for VMware solutions, backed by data storage, networking, and security offerings on the IBM Cloud. The results: Up to 3X performance boost, helping clients seize fleeting opportunities for profit. Security-rich cloud platform with ultra-high availability protects client investments. Hours, not days to fire up new resources, for faster response to emerging requirements.

EMERGING TECHNOLOGIES ACCELERATED BY CLOUD

Internet of Things in the Cloud



In this new era technologies such as Internet of Things, Big Data, artificial intelligence, and blockchain are disrupting existing business models and industries while creating unprecedented opportunities for businesses to differentiate themselves and create value for their clients.

- The power, scale, dynamic nature, and economics of the cloud resources make cloud computing a key enabler for adoption and evolution of these emerging technologies.

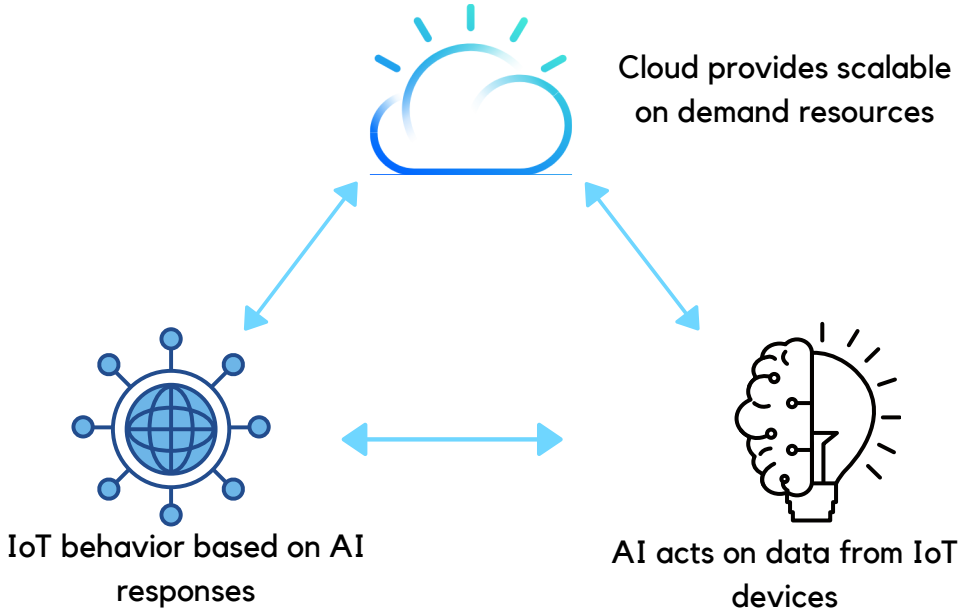
- The Internet of Things, or IoT, is a giant network of connected things and people that have changed much of how we live our daily lives - from the way we drive, to how we make purchases, monitoring our personal health, and even how we get energy for our homes

- Smart devices and sensors are continuously tracking and collecting data. For example, a smart building could have thousands of sensors measuring all kinds of data related to thermal, optical, structural, and environmental stimuli. An unprecedented amount of data is being generated, putting a tremendous strain on the Internet. That is where the cloud comes in, by connecting the IoT device user to the cloud - be it for device registration, device identity, storing data, or accessing enterprise data. Data collected through IoT devices is stored and processed on the cloud since IoT devices can be in a state of motion, the cloud serves as a collection point in closest proximity, minimizing the latency in reporting up the data points and providing a response back to the IoT application
- From IOT platforms running entirely on the cloud to the interfaces used by customers to interact these devices, to the backend analytics platforms - cloud computing supports and enables IoT.
- Cloud service providers also offer specialized IoT services designed to help speed up the development of IoT solutions

Let's look at the case study

The rhinos have become one of the the key species that is becoming endangered due to poaching throughout Africa. But now especially in South Africa. Up until now, poachers have been increasing in numbers, and they become more militarized with weapons. And so of course we've had to do the same. This is not sustainable. The only way to do this better, is to bring in technology and things that they do not have. This endangered species is getting help from some unexpected friends, the zebra and antelope. They're wearing IoT sensors connected to the IBM cloud. When poachers enter the area, the animals run for it, which alerts Rangers who can track their emotions and help stop them before any harm is done. It's a smart way to help increase the Rhino population and turn the poachers into the endangered species. In the next video we're going to look at how artificial intelligence on the cloud is impacting businesses.

Artificial Intelligence on the Cloud



Making sense of the endless streams of data is where Artificial Intelligence, or AI, comes in. Many of the applications where we apply AI today simply wouldn't have been possible without the scalable, on-demand computing offered by the cloud. There is a three-way relationship between AI, IoT, and Cloud. Just as AI consumes the data produced by IoT devices, the IoT devices' behavior can be dictated based on responses from AI

For example, Smart Assistants, a common type of IoT device, continues to learn about the user's preferences as usage grows, such as the songs they like, their home temperature settings, preferred meal times, and over time they anticipate their actions based on the user's past history. So, what we see is a symbiotic relationship between IoT, AI, and Cloud.

IoT delivers the data, AI powers the insights, and both these emerging technologies leverage cloud's scalability and processing power to provide value to individuals and businesses alike.

Let's look at how United States Tennis Association (USTA), is using AI on cloud to deliver unique digital experiences to millions of fans around the world

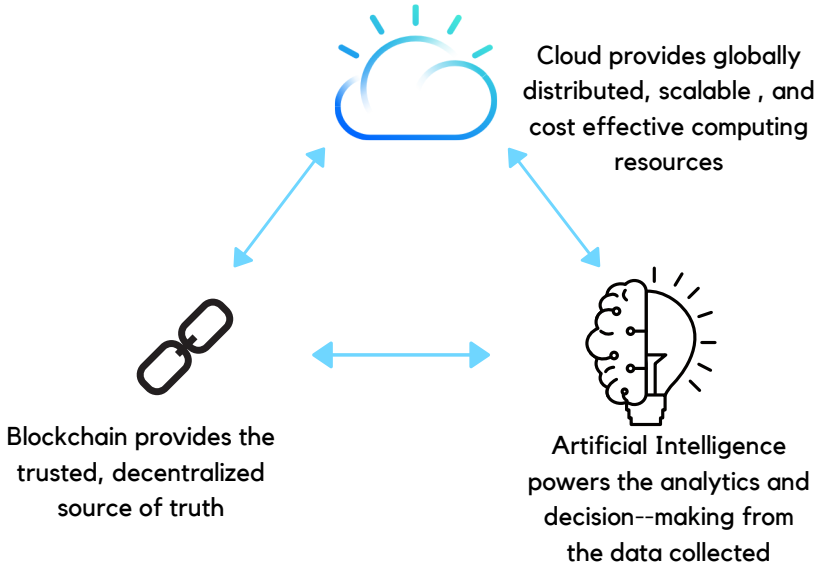
For two weeks at the end of every summer, tennis fans around the world turn their eyes to New York city, and the US Open. Hundreds of thousands onsite, and millions more online. But where you see tennis, IBM sees data; the scores and statistics, the sights, the sounds. IBM integrates and analyzes the data flowing from the court. And delivers unique digital experiences to more than ten million tennis fans around the world. And we do it all in the IBM Cloud. The IBM Cloud is the digital foundation of the US Open. It scales rapidly to meet a five thousand percent increase in web traffic. And it delivers a consistant experience to our fans all around the globe. And with Watson on the IBM Cloud, we can engage fans in unique ways, year after year. Slam Tracker analyzes more than twenty-six million historical data points. It gives fans deep insight into featured matches, and it can see the momentum of a match shifting in real time. AI Highlights uses Watson to process thousands of hours of US Open video. It can hear the cheers of the crowd. It can see a player celebrating. And it knows what makes a great tennis highlight. And this year we're putting the power of AI Highlights into the hands of US players and coaches. Watson is analyzing match video, so coaches can quickly find the footage they need to guide the development of their players. And if you need to know where to park, find a good burger, or grab the latest US Open gear, you can find the answers with the Guest Information feature in the US Open app and mobile web, using Watson. We work with IBM because they keep us on the cutting edge of the fan experience. They help us to adopt the latest technology, like Cloud and AI. And they bring data to life in a way that's accessible and engaging for our fans.

Blockchain and Analytics in the cloud

Blockchain is a secure, distributed, open technology that can help speed up processes, lower costs, and build transparency and traceability in transactional applications. It is an immutable Network allowing members to view only those transactions that are relevant to them. The more open, diverse, and distributed the network, the stronger the trust and transparency in the data and transactions

A 3-Way Relationship

Blockchain and AI, much like IoT and AI, powered by the cloud, also have a three-way relationship. Where blockchain technology provides the trusted, decentralized source of truth, AI powers the analytics and decision-making from the data collected, and cloud provides globally distributed, scalable, and cost-efficient computing resources to support both the unprecedented amounts of data being collected and the processing power required to draw insights from this data



How Blockchain Benifits AI

Blockchain serves to make AI more understandable by recording the data and variables that go into a decision made in an AI algorithm, leading to greater trust and transparency in the conclusions and decisions made by these algorithms. Let's look at how blockchain on the cloud is helping farmers reduce waste at times of recall by building traceability and transparency in the food supply chain.

Let's look at how blockchain on the cloud is helping farmers reduce waste at times of recall by building traceability and transparency in the food supply chain

For farmers here, this is our life's work. 60% of the nation's lettuce is grown right here in Salinas. When it comes down to how plants are looked at, I really relate back to how humans are raised and nurtured. I want to make sure that everything is safe before it leaves the ranch. But when a recall happens, perfectly good food goes to waste. You have to take all product off your shelf, no matter what age, no matter where it came from. And it takes resources to grow those things. Now we're actually eating into our future food supply. But we've gotta way around that. With Blockchain technology on the IBM cloud we're able to track our product within seconds. Giving the consumers instant access where the product came from, in case there's any recall so we don't have to take all the food off the shelves. Having that instant access allows you to reduce the waste. There's a lot of starving people in this world. I want to be a generation that fixes that.

Analytics on Cloud

Analytics technologies on the cloud leverage the flexibility, scalability, and computing resources available on the cloud.

- From tracking trends on social media to predict future events,
- analyzing data to build machine learning models that can be deployed in cognitive applications
- cloud provides the integrated environment that is required to leverage data for continuous improvement and accelerated business growth.

Let's look at how KONE has invested in cloud and IoT technologies to power a data analytics and predictive maintenance solution for the city more than 1 billion people daily

At KONE we manufacture elevators, escalators, auto walks, and doors All of these devices are streams of data that we are collecting. In order to process those streams, we need a scalable way of handling the amount of data that is coming in. And that's where cloud function fits in perfectly. We handle that data with event-driven architecture. We use functions to persist that data, and to generate further events on that data, that are then utilized and consumed by applications, our customers and users. In our analytics platform, we analyzed the set of data and we generate value predictive in a sense that we can predict the failure rate to a certain percentage that is about to happen in the future for our equipment. And this allows us to perform predictive maintenance. And this is kind of the whole concept that we have behind our 24/7 connected services, which is a promise to our customers. That the equipment is connected to the cloud and we are monitoring it. And that's where we generate the real a value for our customers. At the moment we use almost all aspects of the IBM cloud. We use storage from the cloud. We use cloud function. We use messaging services. We use IoT services. So a number of services already in use and platform. And that use will only grow as our digital footprint in the industry grows.

EMERGING TECHNOLOGIES ACCELERATED BY CLOUD SUMMARY

Emerging technologies, powered by the cloud, are disrupting existing business models and creating unprecedented opportunities for businesses to grow, innovate, and create value for their customers. Some case studies that demonstrate how the use of emerging technologies on the cloud is creating value for millions around the world:

- The use of the Internet of Things on the cloud to combat poaching of endangered rhinos in South Africa
- Artificial Intelligence on the cloud being leveraged to deliver unique digital experiences to millions of fans around the world by the United States Tennis Association
- Blockchain on the cloud helping farmers reduce waste by building traceability and transparency in the food supply chain
- The use of data analytics for driving predictive maintenance solutions for a city's infrastructure by KONE

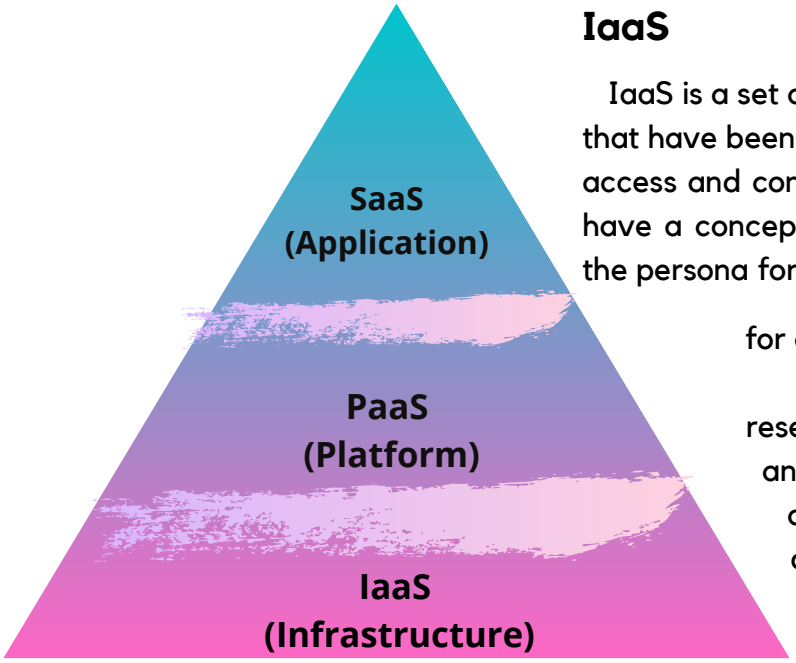
MODULE 2: Cloud Computing Models

MODULE 2: Cloud Computing Models

- Service Models
- Deployment Models
- LAB: create an IBM cloud account

SERVICE MODELS

Overview of Cloud Service Models



IaaS

IaaS is a set of compute networking and storage resources that have been virtualized by a vendor so that a user can access and configure them any way they want. In design we have a concept of talking about users, called personas, and the persona for IaaS is a system admin, or an IT admin.

for example, IaaS is like leasing a car. So if you've ever leased a car, you probably did a lot of research, and you care about the specs of the car and their performance. You care about the color of the car, what kind of car it is. You're the one driving and you're the one paying for it. You're also paying for the gas and any tolls or maintenance.

PaaS

PaaS takes advantage of all the virtualized resources from Iaas and then just abstracts them away, so the user doesn't have to worry about managing any of those virtualized resources.
The user for PaaS is not a system admin, usually.

For example, for platform as a service that's more like renting a car. So say you're on vacation and you just got off at the air Airport and you're going to pick up your rental car. You don't really care what color it is. You don't even care about the specs of it, but you're still driving and you're paying for the gas and any tolls you go through.

SaaS

Software as a Service that's the easy one. Software as a Service is just software that you don't have to install on your machine and you don't have to manually update. And so the user for Software as a Service could be anyone. In fact, if you're watching this on YouTube right now, then you're a user of Software as a Service. It's usually charged on a subscription model rather than a one-time license fee.

Software as a Service is again the easiest one. That one's more like getting a taxi or an uber. So with the taxi or an uber, you don't care at all about what kind of car it is, what color it is. And in fact, you're not even the one driving, or paying for gas, or any tolls because that's baked into the price.

- In IaaS the cloud provider manages the physical resources, data centers, cooling power, Network and security, as well as computing resources that include servers and storage.

- With PaaS, the provider, in addition to the computing resources, also manages the platform infrastructure which includes the operating systems, development tools, databases, and business analytics.

- In the SaaS model, in addition to the infrastructure and the platform resources, the provider also hosts and manages the applications and data. In the next video, we'll take a closer look at infrastructure-as-a-service its features, benefits, and some use cases.

IaaS - Infrastructure as a Service

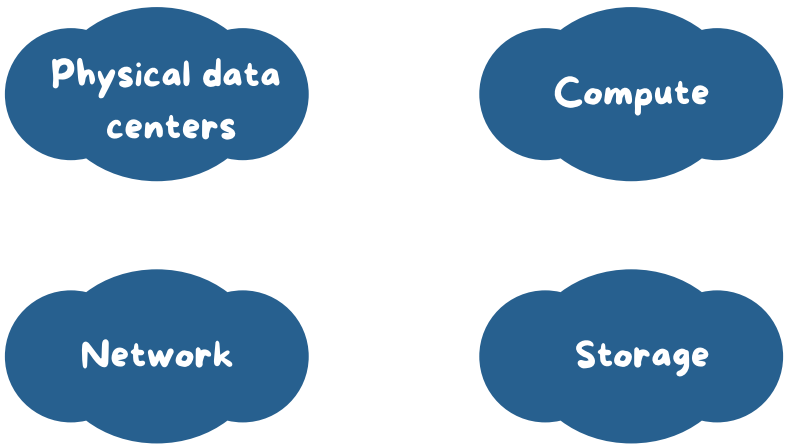
Infrastructure as a Service(IaaS)

Infrastructure-as-a-Service, commonly referred to as "IaaS," – or simply "eye-ass" - is a form of cloud computing that delivers fundamental compute, network, and storage resources to consumers on-demand, over the internet, on a pay-as-you-go basis.

The cloud provider hosts the infrastructure components traditionally present in an on-premises data center as well as the virtualization or hypervisor layer

IaaS Cloud

In an IaaS Cloud environment, customers can create or provision virtual machines (or VMs) in their choice of Region and Zone available from the Cloud Provider. These VMs typically come pre-installed the customer's choice of operating system. The customers can then deploy middleware, install applications, and run workloads on these VMs. **They can also and create storage for their workloads and backups. Cloud providers often provide customers the ability to track and monitor the performance and usage of their cloud services and manage disaster recovery**



Physical data centers: IaaS providers manage large data centers that contain the physical machines required to power the various layers of abstraction on top of them. In most IaaS models, end users do not interact directly with the physical infrastructure but experience it as a service provided to them.

Compute: IaaS providers manage the hypervisors and end-users programmatically provision virtual instances with desired amounts of compute, memory, and storage resources. Cloud compute typically comes with supporting services like auto scaling and load balancing that provide scalability and high performance.

Network: Users get access to networking resources on the cloud through virtualization or programmatically, through APIs.

Storage: There are three types of cloud data storage: **object, file, and block storage**. Object storage is the most common mode of storage in the cloud, given that it is highly distributed and resilient.

Test and Development

IaaS supports a wide array of use cases. We'll look at some typical use cases here. Organizations today are using cloud infrastructure services to enable their teams to set up test and development environments faster, helping create new applications more quickly. By abstracting the low-level components, cloud infrastructure is helping developers focus more on business logic than infrastructure management.

Business continuity and disaster recovery require a significant amount of technology and staff investments. IaaS is helping organizations reduce this cost and make applications and data accessible as usual during a disaster or outage.

Organizations are using cloud infrastructure to deploy their web applications faster and also scale infrastructure up and down as demand fluctuates. Organizations are leveraging the high-performance computing capabilities of cloud infrastructure to solve complex problems involving millions of variables and calculations, such as climate and weather predictions and financial modeling.

Mining massive data sets to locate valuable patterns, trends, and associations requires a huge amount of processing power. Cloud infrastructure not only provides the required high-performance computing but also makes it economically viable.

IaaS Concerns

While there are some concerns regarding the lack of transparency in the cloud infrastructure's configuration and management and dependency on a third-party for workload availability and performance Infrastructure-as-a-Service is the fastest growing cloud model today

PaaS - Platform as a Service

PaaS - Platform as a Service

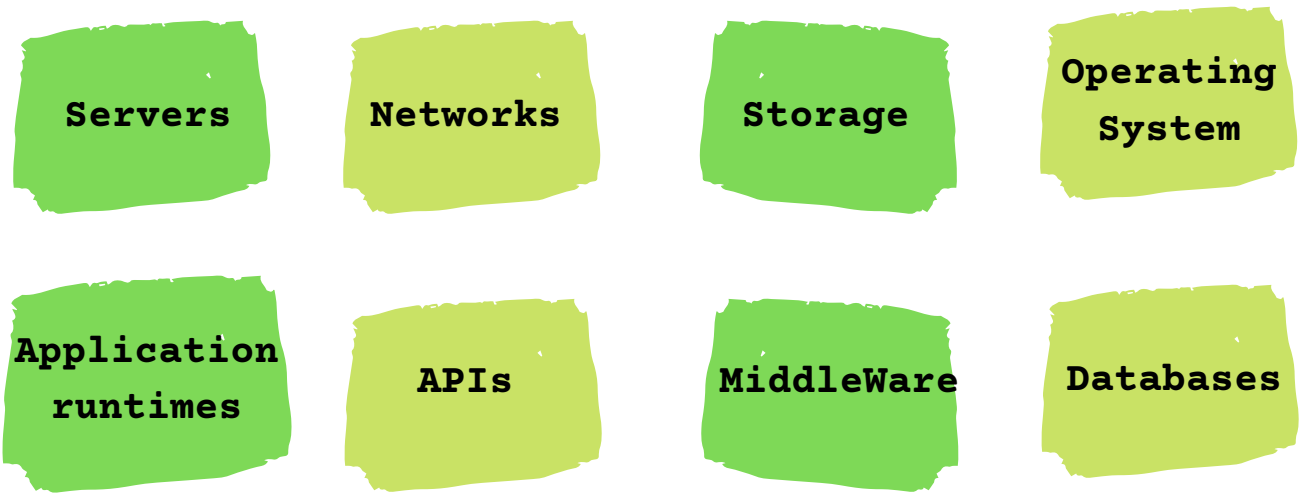
a cloud computing model that provides a complete application platform to

- Develop
- Deploy
- Run
- Manage

created by them or acquired from a third-party

PaaS Provider Host & Manage

The PaaS provider hosts everything



The provider also takes responsibility for the installation, configuration, and operation of the application infrastructure, leaving the user responsible for only the application code and its maintenance. Customers pay for this service on a usage basis and purchase resources on-demand

Essential Characteristics of PaaS

PaaS clouds are distinguished by the high level of abstraction they provide to the users, eliminating the complexity of deploying applications, configuring infrastructure, and provisioning and configuring supporting technologies like load balancers and databases. PaaS clouds provide services and APIs that help simplify the job of developers in delivering elastically scalable and highly available cloud applications. These services typically include a variety of capabilities such as APIs for distributed caching, queuing and messaging, file and data storage, workload management, user identity, and analytics, thus eliminating the need to integrate disparate

components. The PaaS runtime environment executes end-user code according to policies set by the application owner and cloud provider. Many of the PaaS offerings provide developers with rapid deployment mechanisms, or “push and run” mechanism, for deploying and running applications. PaaS offerings support a range of application infrastructure (or middleware) capabilities, such as application servers, database management systems, business analytics servers, mobile back-end services, integration services, business process management systems, rules engines, and complex event processing systems. Such an application infrastructure assists developers by reducing the amount of code that must be written while expanding the application’s functional capabilities. The most important use case for PaaS is strategic—build, test, deploy, enhance, and scale applications rapidly and cost-effectively.

Use Cases

- **API developement and management:**
  Organizations are using PaaS to develop, run, manage, and secure APIs and microservices, which are loosely coupled, independently deployable components and services.
- **Internet of Things, or IoT:**
  PaaS clouds support a broad range of application environments, programming languages, and tools used for IoT deployment
- **Business analytics/intelligence:**
  PaaS tools allow organizations to analyze their data to find business insights that enablemore informed business decisions and predictions
- **Business Process Management:**
  Organizations are using the PaaS cloud to access BPM platform delivered as a service
- **Master Data Management:**
  Organizations are leveraging the PaaS cloud to provide a single point of reference for critical business data such as information about customer transactions and analytical data to support decision making

Advantages of PaaS

Scalability, made possible because of the rapid allocation and deallocation of resources with a pay-as-you-use model offered by PaaS. The APIs, support services, and middleware capabilities that PaaS clouds provide assist developers in focusing their efforts on application development and testing, resulting in faster time to market for their products and services.

SaaS - Software as a Service

Software-as-a-Service, "SaaS", or simply "sass", is a cloud offering that provides users with access to a service provider's cloud-based software. SaaS providers maintain the servers, databases, and code that constitute an application. They also manage access to the application, including security, availability, and performance. Applications reside on a remote cloud network, and users use these applications without having to maintain and update the infrastructure.

SaaS Supports

Email and Collaboration

Core business processes supported by SaaS today include email and collaboration via offerings such as Microsoft's Office 365 and Google's Gmail.

Customer Relationship Management

Customer Relationship Management via services such as NetSuite CRM and Salesforce.

Human Resource Management

Human Resource Management via services from Workday and SAP SuccessFactors, financial management, billing and collaboration, and many more.

Financial Management

According to Forrester Research, SaaS has overtaken on-premises solutions in categories such as human capital management (HCM), customer relationship management (CRM), and collaboration. Solutions once available with several different deployment options are now SaaS-only

Key Characteristics of Software as a Service

- **Multitenant Architecture** : SaaS clouds have a multitenant architecture. Infrastructure and code are maintained centrally and accessed by all users.

- **Manage Privileges and Monitor Data** : SaaS makes it easy for users to manage privileges, monitor data use, and ensure everyone sees the same information at the same time

- **Security, Compliance and maintenance** : Users can customize applications to fit their business processes with point-and-click ease.

- **Customize Applications** : Users can customize the UI to work with their branding guidelines; they can modify data fields and enable or disable features within the business process. These customizations are preserved through upgrades.

- **Subscription Model** : Users pay for the use of the services via a subscription model.

- **Scalable Resources** : The resources can be scaled easily, depending on Service needs.

Key Benefits

Greatly reduce the time from decision to value:
Businesses can directly procure solutions without upfront capital and assistance from IT, greatly reducing the time from decision to value from months to days

Increase workforce productivity and efficiency:
SaaS greatly increases workforce productivity and efficiency.
- Users can access core business apps from wherever they are
- they can also buy and deploy apps in minutes, reducing the typical obstacles enterprises have to test the products they they might use.

Spread out software cost over time
Using SaaS applications, individuals and small enterprises can spread out their software costs over time.

Use Cases

- Organizations are moving to SaaS for their core business needs as part of their strategic transformation to reduce on-premises IT infrastructure and reduce capital expenditure.

- Oragnizaitions are leveraging SaaS to avoid the need for ongoing upgrades, maintenance, and patching, done traditionally by internal IT resources;

- applications run reliably with minimal input, for example, email servers and office collaboration and productivity tools.

- Organizations are increasingly opting for SaaS eCommerce Platforms to manage their websites, marketing, sales, and operations.

- With SaaS, organizations are able to take advantage of the resilience and business continuity of the cloud provider.

- Enterprises are now developing SaaS integration platforms (or SIPs) for building additional SaaS applications, moving SaaS beyond standalone software functionality to a platform for mission-critical applications

Concerns

Primary among them being data ownership and data safety. Security is an important consideration when you're allowing a third-party to maintain business-critical data. And application access relies on a good internet connection—if you're not connected, you cannot access the apps. But the benefits far outweigh the concerns, with SaaS making up the largest segment of the cloud market today.

LESSON SUMMARY

- Cloud computing allows us to utilize technology as a service, leveraging remote resources on-demand, on a pay-as-you-model. There are three main service models available on the cloud—Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS), and Software-as-a-Service (SaaS).
- IaaS provides the fundamental compute, network, and storage resources for customers on-demand.
- PaaS provides customers the hardware, software, and infrastructure to develop, deploy, manage, and run applications created by them or acquired from a third-party.
- SaaS provides access to users to a service provider's cloud-based software. Users simply access the applications on Cloud while the Cloud provider maintains the infrastructure, platform, data, application code, security, availability, and performance of the application.

DEPLOYMENNT MODELS

OVERVIEW OF DEPLOYMENT MODELS

Deployment models indicate where the infrastructure resides, who owns and manages it, and how cloud resources and services are made available to users. The three cloud deployment models include—Public Cloud, Private Cloud, and Hybrid Cloud

Public Cloud

In a public cloud model, users get access to servers, storage, network, security, and applications as services delivered by cloud service providers over the internet. Using web consoles and APIs, users can provision the resources and services they need. The cloud provider owns, manages, provisions, and maintains the infrastructure, renting it out to customers either for a subscription charge or usage-based fee. Users don't own the servers their applications run on or storage their data consumes, or manage the operations of the servers, or even determine how the platforms are maintained. In very much the same way that we consume and pay for utilities such as water, electricity, or gas in our everyday lives, we don't own any of these cloud resources—we make an agreement with the service provider, use the resources, and pay for what we use within a certain period.

Public clouds offer significant cost savings as the provider bears all the capital, operational, and maintenance expenses for the infrastructure and the facilities they are hosted in. It makes scalability as easy as requesting more capacity. However, with a public cloud, the user does not have any control over the computing environment and is subject to the performance and security of the cloud provider's infrastructure. There are several public cloud providers in the market today, such as Amazon Web Services, Microsoft Azure, IBM Cloud, Google Cloud Platform, and Alibaba Cloud. While all providers include a common set of core services, such as servers, storage, network, security, and databases, they also offer a wide spectrum of niche services with varied payment options.

Public cloud characteristics

A public cloud is a virtualized multi-tenant architecture enabling tenants or users to share computing resources, residing outside their firewalls.

The cloud providers pool of resources, including infrastructure, platforms, and software, are NOT dedicated for use by a single tenant or organization. Resources are distributed on an as-needed basis offered through a variety of subscription and pay-as-you-go models.

Public cloud benefits

- On-demand resources:
  allowing applications to respond seamlessly to fluctuations in demand.
- Economies of Scale:
  Considering the large number of users that share the centralized cloud resources on-demand, the public cloud offers the most significant economies of scale.
- Highly reliable:
  The sheer number of server and network resources available on the public cloud means that a public cloud is highly reliable—if one physical component fails, the service still runs unaffected on the remaining available components

Public cloud concerns

key among them being security and data sovereignty compliance. Security issues such as data breaches, data loss, account hijacking, insufficient due diligence, and system and application vulnerability seem to be some of the fears users continue to have concerning security in the public cloud. With data being stored in different locations and accessed across national borders, it has also become increasingly critical for companies to be compliant with data sovereignty regulations governing the storage, transfer, and security of data. A service provider's ability to not just keep up with the regulations, but also the interpretation of these regulations, is a concern shared by many businesses

Use cases of Public cloud

1. Organizations are increasingly opting to access cloud-based applications and platforms so their teams can focus on building and testing applications, and reducing time-to-market for their products and services.
2. Businesses with fluctuating capacity and resourcing needs are opting for the public cloud. Organizations are using public cloud computing resources to build secondary infrastructures for disaster recovery, data protection, and business continuity.
3. More and more organizations are using cloud storage and data management services for greater accessibility, easy distribution, and backing up their data.
4. IT departments are outsourcing the management of less critical and standardized business platforms and applications to pubic cloud providers.

Private Cloud