CLOUD COMPUTING

Cloud computing transforms IT infrastructure into a utility: It lets you 'plug into' infrastructure via the internet, and use computing resources without installing and maintaining them on-premises.
Cloud computing is on-demand access, via the internet, to computing resources—applications, servers (physical servers and virtual servers), data storage, development tools, networking capabilities, and more—hosted at a remote data center managed by a cloud services provider (or CSP). The CSP makes these resources available for a monthly subscription fee or bills them according to usage.
Compared to traditional on-premises IT, and depending on the cloud services you select, cloud computing helps do the following:

- **Lower IT costs:** Cloud lets you offload some or most of the costs and effort of purchasing, installing, configuring, and managing your own on-premises infrastructure.
- **Improve agility and time-to-value**: With cloud, your organization can start using enterprise applications in minutes, instead of waiting weeks or months for IT to respond to a request, purchase and configure supporting hardware, and install software. Cloud also lets you empower certain users—specifically developers and data scientists—to help themselves to software and support infrastructure.
- **Scale more easily and cost-effectively**: Cloud provides elasticity—instead of purchasing excess capacity that sits unused during slow periods, you can scale capacity up and down in response to spikes and dips in traffic. You can also take advantage of your cloud provider's global network to spread your applications closer to users around the world.

The term '**cloud computing'** also refers to the technology that makes cloud work. This includes some form of *virtualized IT infrastructure*—servers, operating system software, networking, and other infrastructure that's abstracted, using special software, so that it can be pooled and divided irrespective of physical hardware boundaries. For example, a single hardware server can be divided into multiple virtual servers.

Virtualization enables cloud providers to make maximum use of their data center resources. Not surprisingly, many corporations have adopted the cloud delivery model for their on-premises infrastructure so they can realize maximum utilization and cost savings vs. traditional IT infrastructure and offer the same self-service and agility to their end-users.

If you use a computer or mobile device at home or at work, you almost certainly use some form of cloud computing every day, whether it's a cloud application like Google Gmail or Salesforce, streaming media like Netflix, or cloud file storage like Dropbox. According to a recent survey, 92% of organizations use cloud today (link resides outside IBM), and most of them plan to use it more within the next year.

Examples of Cloud Computing

Now we are going to discuss the Examples of Cloud Computing which are mention below :

1. **Dropbox, Facebook, Gmail Cloud** can be used for storage of files. The advantage is an easy backup. They automatically synchronize the files from the desktop. Dropbox allowing users to access files and storage up to 1 terabyte of free storage. Social Networking platform requires a powerful hosting to manage and store data in real-time. Cloud-based communication provides click-to-call capabilities from social networking sites, access to the Instant messaging system.

2. Banking, Financial Services Consumers store financial information to cloud computing serviced providers. They store tax records as online backup services.

3. Health Care Using cloud computing, Medical professionals host information, analytics and do diagnostics remotely. As healthcare also comes in the list of examples of cloud computing it allows other doctors around the world to immediately access this medical information for faster prescriptions and updates. Application of cloud computing in health care includes telemedicine, public and personal health care, E-health services and bioinformatics.

4. Education This is useful in institutions of higher learning provide benefits to universities and colleges so henceforth Education comes in the examples of cloud computing. Google and Microsoft provide various services free of charge to staff and students in different learning institutions. Several Educational institutions in united states use them to improve efficiency, cut on costs. ExampleGoogle App Education (GAE). They allow the user to use their personal workspace, teaching becomes more interactive.

5. Government They deliver e-Governance services to citizens using cloud-based IT services. They have the technology to handle large transactions, citizens can see fewer congestion bottlenecks.

6. Big data Analytics Big data analytics is another example of Cloud computing, As cloud computing enables data scientist in analyzing their data patterns, insights, correlations, predictions and help in good decision making. There are many open sources of big tools like Hadoop, Cassandra.

Types of cloud computing
Public cloud

Public cloud is a type of cloud computing in which a cloud service provider makes computing resources—anything from SaaS applications, to individual virtual machines (VMs), to bare metal computing hardware, to complete enterprise-grade infrastructures and development platforms—available to users over the public internet. These resources might be accessible for free, or access might be sold according to subscription-based or pay-per-usage pricing models.

The public cloud provider owns, manages, and assumes all responsibility for the data centers, hardware, and infrastructure on which its customers' workloads run, and it typically provides high-bandwidth network connectivity to ensure high performance and rapid access to applications and data.

Public cloud is a multi-tenant environment—the cloud provider's data center infrastructure is shared by all public cloud customers. In the leading public clouds—Amazon Web Services (AWS), Google Cloud, IBM Cloud, Microsoft Azure, and Oracle Cloud—those customers can number in the millions.

The global market for public cloud computing has grown rapidly over the past few years, and analysts forecast that this trend will continue; industry analyst Gartner predicts that worldwide public cloud revenues will exceed USD 330 billion by the end of 2022 (link resides outside IBM).

Many enterprises are moving portions of their computing infrastructure to the public cloud because public cloud services are elastic and readily scalable, flexibly adjusting to meet changing workload demands. Others are attracted by the promise of greater efficiency and fewer wasted resources since customers pay only for what they use. Still others seek to reduce spending on hardware and on-premises infrastructures.

Private cloud

Private cloud is a cloud environment in which all cloud infrastructure and computing resources are dedicated to, and accessible by, one customer only. Private cloud combines many of the benefits of cloud computing—including elasticity, scalability, and ease of service delivery—with the access control, security, and resource customization of on-premises infrastructure.

A private cloud is typically hosted on-premises in the customer's data center. But a private cloud can also be hosted on an independent cloud provider's infrastructure or built on rented infrastructure housed in an offsite data center.

Many companies choose private cloud over public cloud because private cloud is an easier way (or the only way) to meet their regulatory compliance requirements. Others choose private cloud because their workloads deal with confidential documents, intellectual property, personally identifiable information (PII), medical records, financial data, or other sensitive data.

By building private cloud architecture according to cloud native principles, an organization gives itself the flexibility to easily move workloads to public cloud or run them within a *hybrid cloud* (see below) environment whenever they're ready.

Hybrid cloud

Hybrid cloud is just what it sounds like—a combination of public and private cloud environments. Specifically, and ideally, a hybrid cloud connects an organization's private cloud services and public clouds into a single, flexible infrastructure for running the organization's applications and workloads.

The goal of hybrid cloud is to establish a mix of public and private cloud resources—and with a level of orchestration between them—that gives an organization the flexibility to choose the optimal cloud for each application or workload and to move workloads freely between the two clouds as circumstances change. This enables the organization to meet its technical and business objectives more effectively and cost-efficiently than it could with public or private cloud alone.

Multicloud and hybrid multicloud

Multicloud is the use of two or more clouds from two or more different cloud providers. Having a multicloud environment can be as simple using email SaaS from one vendor and image editing SaaS from another. But when enterprises talk about multicloud, they're typically talking about using multiple cloud services—including SaaS, PaaS, and IaaS services—from two or more of the leading public cloud providers. In one survey, 85% of organizations reported using multicloud environments.

Hybrid multicloud is the use of two or more public clouds together with a private cloud environment.

Organizations choose multicloud to avoid vendor lock-in, to have more services to choose from, and to access to more innovation. But the more clouds you use—each with its own set of management tools, data transmission rates, and security protocols—the more difficult it can be to manage your environment. Multicloud management platforms provide visibility across multiple provider clouds through a central dashboard, where development teams can see their projects and deployments, operations teams can keep an eye on clusters and nodes, and the cybersecurity staff can monitor for threats.

Cloud computing services

IaaS (Infrastructure-as-a-Service), PaaS (Platform-as-a-Service) , and SaaS (Software-as-a-Service) are the three most common models of cloud services, and it's not uncommon for an organization to use all three. However, there is often confusion among the three and what's included with each:

SaaS (Software-as-a-Service)

SaaS—also known as cloud-based software or cloud applications—is application software that's hosted in the cloud and that you access and use via a web browser, a dedicated desktop client, or an API that integrates with your desktop or mobile operating system. In most cases, SaaS users pay a monthly or annual subscription fee; some may offer ‘pay-as-you-go’ pricing based on your actual usage.

In addition to the cost savings, time-to-value, and scalability benefits of cloud, SaaS offers the following:

- **Automatic upgrades**: With SaaS, you take advantage of new features as soon as the provider adds them, without having to orchestrate an on-premises upgrade.
- **Protection from data loss**: Because your application data is in the cloud, with the application, you don’t lose data if your device crashes or breaks.

SaaS is the primary delivery model for most commercial software today—there are hundreds of thousands of SaaS solutions available, from the most focused industry and departmental applications, to powerful enterprise software database and AI (artificial intelligence) software.

PaaS (Platform-as-a-Service)

PaaS provides software developers with on-demand platform—hardware, complete software stack, infrastructure, and even development tools—for running, developing, and managing applications without the cost, complexity, and inflexibility of maintaining that platform on-premises.

With PaaS, the cloud provider hosts everything—servers, networks, storage, operating system software, middleware, databases—at their data center. Developers simply pick from a menu to ‘spin up’ servers and environments they need to run, build, test, deploy, maintain, update, and scale applications.

Today, PaaS is often built around *containers*, a virtualized compute model one step removed from virtual servers. Containers virtualize the operating system, enabling developers to package the application with only the operating system services it needs to run on any platform, without modification and without need for middleware.

Red Hat OpenShift is a popular PaaS built around Docker containers and Kubernetes, an open source container orchestration solution that automates deployment, scaling, load balancing, and more for container-based applications.

IaaS (Infrastructure-as-a-Service)

IaaS provides on-demand access to fundamental computing resources–physical and virtual servers, networking, and storage—over the internet on a pay-as-you-go basis. IaaS enables end users to scale and shrink resources on an as-needed basis, reducing the need for high, up-front capital expenditures or unnecessary on-premises or ‘owned’ infrastructure and for overbuying resources to accommodate periodic spikes in usage.

In contrast to SaaS and PaaS (and even newer PaaS computing models such as containers and serverless), IaaS provides the users with the lowest-level control of computing resources in the cloud.

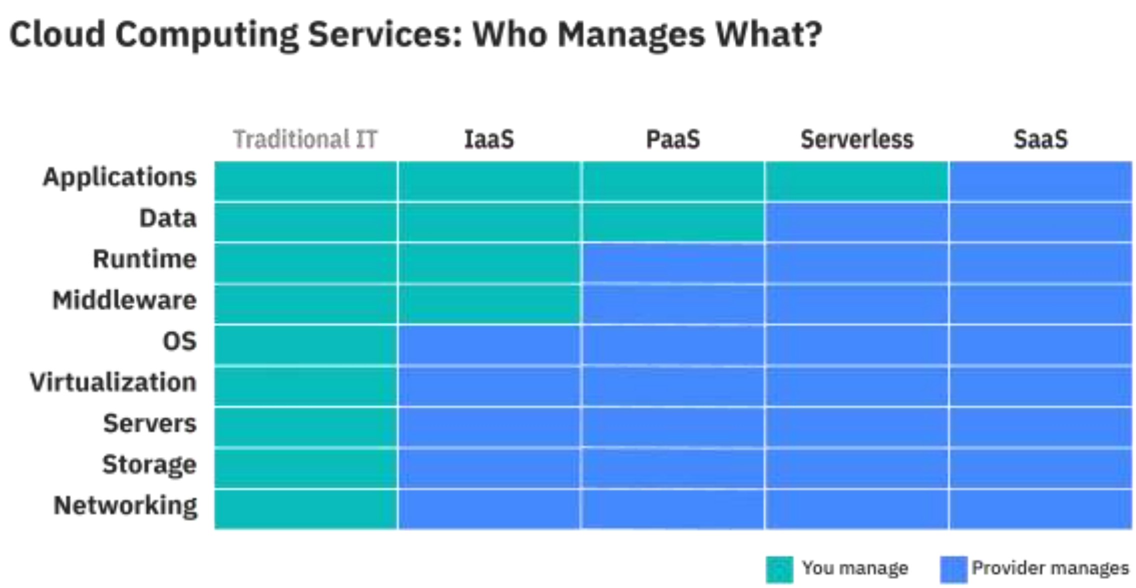
IaaS was the most popular cloud computing model when it emerged in the early 2010s. While it remains the cloud model for many types of workloads, use of SaaS and PaaS is growing at a much faster rate.

Serverless computing

Serverless computing (also called simply *serverless*) is a cloud computing model that offloads all the backend infrastructure management tasks–provisioning, scaling, scheduling, patching—to the cloud provider, freeing developers to focus all their time and effort on the code and business logic specific to their applications.

What's more, serverless runs application code on a per-request basis only and scales the supporting infrastructure up and down automatically in response to the number of requests. With serverless, customers pay only for the resources being used when the application is running—they never pay for idle capacity.

FaaS, or Function-as-a-Service, is often confused with serverless computing when, in fact, it's a subset of serverless. FaaS allows developers to execute portions of application code (called functions) in response to specific events. Everything besides the code—physical hardware, virtual machine operating system, and web server software management—is provisioned automatically by the cloud service provider in real-time as the code executes and is spun back down once the execution completes. Billing starts when execution starts and stops when execution stops. Learn more about serverless



Cloud security
Traditionally, security concerns have been the primary obstacle for organizations considering cloud services, particularly public cloud services. In response to demand, however, the security offered by cloud service providers is steadily outstripping on-premises security solutions.

Nevertheless, maintaining cloud security demands different procedures and employee skillsets than in legacy IT environments. Some cloud security best practices include the following:

- Shared responsibility for security: Generally, the cloud provider is responsible for securing cloud infrastructure and the customer is responsible for protecting its data within the cloud—but it's also important to clearly define data ownership between private and public third parties.
- Data encryption: Data should be encrypted while at rest, in transit, and in use. Customers need to maintain full control over security keys and hardware security module.
- User identity and access management: Customer and IT teams need full understanding of and visibility into network, device, application, and data access.
- Collaborative management: Proper communication and clear, understandable processes between IT, operations, and security teams will ensure seamless cloud integrations that are secure and sustainable.
- Security and compliance monitoring: This begins with understanding all regulatory compliance standards applicable to your industry and setting up active monitoring of all connected systems and cloud-based services to maintain visibility of all data exchanges between public, private, and hybrid cloud environments.

Cloud use cases

With 25% of organizations planning to move *all* their applications to cloud within the next year, it would seem that cloud computing use cases are limitless. But even for companies not planning a wholesale shift to the cloud, certain initiatives and cloud computing are a match made in IT heaven.

Disaster recovery and business continuity have always been a natural for cloud because cloud provides cost-effective redundancy to protect data against system failures and the physical distance required to recover data and applications in the event of a local outage or disaster. All of the major public cloud providers offer Disaster-Recovery-as-a-Service (DRaaS).

Anything that involves storing and processing huge volumes of data at high speeds—and requires more storage and computing capacity than most organizations can or want to purchase and deploy on-premises—is a target for cloud computing. Examples include:

- Big data analytics
- Internet of Things (IoT)
- Artificial intelligence—particularly machine learning and deep learning applications

For development teams adopting Agile or DevOps (or DevSecOps) to streamline development, cloud offers the on-demand end-user self-service that keeps operations tasks—such as spinning up development and test servers—from becoming development bottlenecks.