



Cloud Applications, Infrastructure and Platforms: Journey of Cloud

Pramod Kumar Gudla

Principal Software Engineer, Oracle India, Hyderabad

Dr. Sree Rama Chandra Murthy Dasika

Professor in CSE, Anurag University, Hyderabad-500085, India

Abstract

Application, platform, and infrastructure in cloud computing environment to provide resources of server to the various Cloud computing is a significant advancement in the delivery of information technology and services. It is a recent trend in Information Technology that moves computing and data away from desktop and portable Personal Computers into large data centers.

The main advantage of cloud computing is that customers do not have to pay for infrastructure, its installation, required man power to handle such infrastructure and maintenance.

Introduction

Cloud infrastructure refers to the hardware and software components that support the computing requirements and it underpins cloud computing by disaggregating the functions and features of those hardware and software components.

Then, a cloud service provider or Information Technology (IT) department in the case of private cloud hosts those virtualized resources and delivers them to users over the internet or a network.

These resources include Virtual Machines (VMs) and components, such as servers, memory, network switches, firewalls, load balancers and storage.

These resources often support extensive and task-specific services such as Artificial Intelligence (AI) and Machine Learning (ML) [1] as shown in Figure 1.

Literature Survey

Cloud computing infrastructure is collection of hardware and software elements needed to enable cloud computing.

It includes computing power, networking, storage as well as an interface for users to access their virtualized resources.

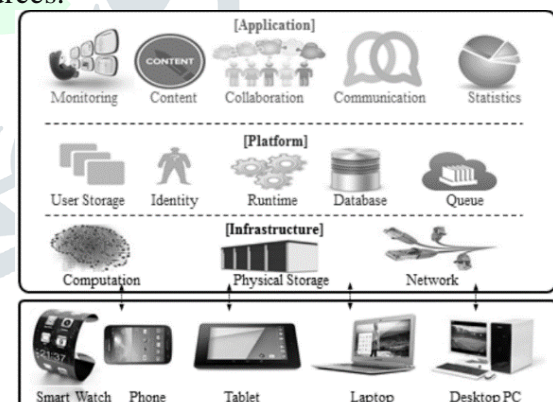


Figure 1

Cloud Computing

Cloud computing refers to the use of hosted services, such as data storage, servers, databases, networking, and software over the internet.

The data is stored on physical servers, which are maintained by a cloud service provider.

Protect your data more cost-efficiently and at massive scale by transferring your data over the Internet to an offsite cloud storage system that's accessible from any location and any device. Cloud storage has grown increasingly popular among individuals who need larger storage space and for businesses seeking an efficient off-site data back-up solution.

Cloud computing can also be thought of as utility computing or on-demand computing.

The name cloud computing was inspired by the cloud symbol that's often used to represent the internet in flowcharts and diagrams [2].

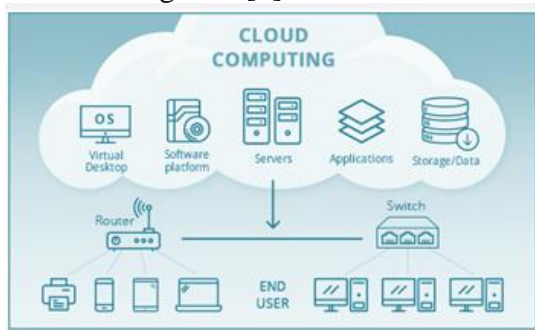


Figure 2

Everyday life activities such as Banking, Email, Media Streaming, and Ecommerce all use the Cloud. On the Business side, Applications, Infrastructure, Storage, and Sales/CRM all have their presence out in the Cloud. Most major cloud service providers including Amazon Web Services (AWS), Google Cloud, IBM Cloud and Microsoft Azure offer IaaS with their cloud computing services as shown in Figure 2.

Components of Cloud Infrastructure

In a cloud computing architecture, cloud infrastructure refers to the back-end technology elements found within most enterprise data centers, servers, and persistent storage and networking equipment, but on a much greater scale as shown in Figure 3

Some large cloud providers, including hyper scale cloud companies, such as Facebook and LinkedIn, form partnerships with vendors to design custom infrastructure components that are optimized for specific needs, such as power efficiency or workloads that include big data and Artificial Intelligence (AI).

Servers: Major public cloud providers offer services based on shared, multi-tenant servers. Cloud infrastructure typically consists of high-density systems with shared power; often, these are multi-socket and multicore servers.

Storage: Unlike most traditional data center infrastructures, cloud infrastructure uses locally attached storage like Solid State Drives (SSDs) and Hard Disk Drives (HDDs). These persistent storage systems are aggregated using a Distributed File System (DFS) designed for a particular storage scenario, such as object, big data or block. Decoupling the storage control and management from the physical infrastructure via a distributed file system simplifies scaling. It helps cloud providers match capacity to user's workload by incrementally adding compute nodes with the requisite number and type of local disks, rather than in large amounts via a large storage chassis.

Networking

Cloud computing mostly depends upon high bandwidth connectivity to transmit the data, so cloud infrastructure also includes typical equipment for local area networks, such as switches and routers, as well as virtual networking support and load balancing to distribute network traffic [3].

Cloud Computing Stack



Figure 3

Necessity to build Cloud Infrastructure

- Standardized architecture designed to share IT resources, provide scalability and elasticity for workloads, policy-based configurations and governance.
- Integrations, Orchestration, Security, Reporting.
- Visibility should be a primary focus when you build a cloud. Adapting to the changing resource requirements and security parameters inherent in a cloud environment requires quick, data-driven decisions that can only be accomplished with a clear view of the overall cloud system [4].

Benefits of using Cloud Infrastructure

Flexibility: procure resources that are rapidly accessible and self-manage the resources to better align to business needs.

Reliability: expansive infrastructure and redundancy options through availability zones deliver reliability at a scale beyond any single customer's in-house resources.

Cost: cloud infrastructure eliminates upfront capital costs associated with on-premises infrastructure and instead follows a consumption-based model. Cloud providers constantly invest in and improve their abilities to protect their infrastructure from security threats [5].

Challenges to be considered when using a cloud infrastructure

Shared security: Although cloud providers are vigilant to secure their cloud infrastructure, it becomes complex to oversee that scale of infrastructure and services. Moreover, the shared responsibility model means providers only secure their infrastructure. Customers are responsible for protecting their workloads and data through proper configuration, access controls and monitoring.

Visibility/Management: The virtualization layer of a cloud infrastructure generally means customers do not have visibility into the actual physical hardware upon which their workloads run. Public cloud providers do offer dedicated hardware, control over entire server stack and also typically higher performance but at higher costs.

Out-of-control cost

Model works for cloud customers as long as they closely allocate and monitor the services. Overprovisioning, inactive resources and failure to understand service dependencies all can quickly add up to unexpected cloud costs. Closely monitor and manage the cloud use as they consume increasingly granular, complex and integrated cloud services [6].

Methodology

Cloud Computing Services

IaaS, PaaS and SaaS are the three most popular types of cloud service offerings. They are sometimes referred to as cloud service models or cloud computing service models.

Infrastructure as a Service (IaaS)

Service model that forms the foundation for your cloud technology deployment. Through an IaaS provider, you gain on-demand access via the internet to core IT resources including virtual, dedicate hardware, networking and storage as shown in Figure 4.

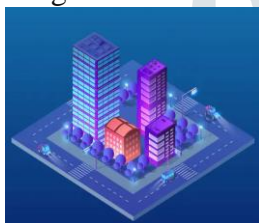


Figure 4

IaaS products allow organizations to manage their business resources (network, storage and servers on the Cloud)

Software as a Service (SaaS)

Service model that provides you access to a completed software product, run and managed by the service provider. Most SaaS solutions tend to be end-user applications.

Software as a service (or SaaS) is a way of delivering applications over the Internet as a service.

Instead of installing and maintaining software you simply access it via the Internet, keeping yourself away from complex software and hardware management as shown in Figure 5.



Figure 5

Platform as a Service (PaaS)

Service model you access combined hardware and software tools through a service provider. Most commonly used for the application development. PaaS products allow businesses and developers to host, build, and deploy Consumer-facing apps as shown in Figure 6.



Figure 6

Cloud Deployment Models

Once you have selected your chosen cloud service(s) you have the option of four cloud computing deployment models as shown in Figure 7.

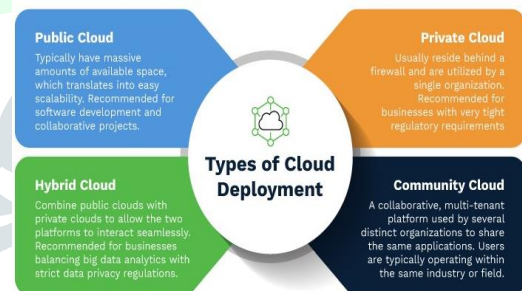


Figure 7

Public cloud is the provision of computing services over the public internet by a third-party provider. Public cloud services are available to anyone who wants to use them and can be free or paid to use.

Private cloud is the provision of computing services for a single organization access over the internet or a private internal network. A private cloud can be managed internally or by a third-party provider.

Hybrid cloud is the provision of computing services through a combination of public cloud and private cloud deployments. This type of deployment allows the sharing of data and applications between both cloud environments.

Community Cloud is built on the shared infrastructure of several organizations with a common concern.

Community clouds are popular as they further split the resource costs between the organizations involved. Public cloud model is the most widely used cloud service and proven to be the popular option for web applications, file sharing, and non-sensitive data storage. Service provider owns and operates the needed hardware [7].

Cloud Management refers to the exercise of control over public, private or hybrid cloud infrastructure resources and services. A well-designed cloud management strategy can help IT pros maintain control over those dynamic and scalable computing environments. But that is no easy task [8].

Cloud Management Components



Figure 8

Cloud Security Services

- **Auditing** track all user activity and create an audit log of who did what, where, and when within your cloud platform.
- **Compliance** help you track and maintain regulatory compliance.
- **DDoS Protection** prevent application downtime and minimize the latency of your infrastructure as shown in Figure 8.
- **Encryption** prevent your data from being accessed even in the event of theft.
- **Firewalls** filter malicious web traffic and centrally manage firewall rules.
- **Identity and Access Management** manage user identities and control who has access to what, and what they can do with that access
- **Threat Detection** identify potential threats in cloud environments [9]

SaaS vs PaaS vs IaaS

Matching IaaS, PaaS, and SaaS to meet our requirement



Figure 9

Demonstrates how infrastructure as a service (IaaS), platform as a service (PaaS), and software as a service (SaaS) compare in terms of who manages what and when particular model of service is required and useful. As we map our path to the cloud, the most important decisions revolve around how much we can and want to manage our self and how much we want our service provider to manage. It helps us to explore all the options to discover which services match our needs today and which we want to plan for in the future as shown in the Figure 9.

On-premise IT infrastructure presents the biggest level of responsibility to you as a user and manager. When your hardware and software are all on-premises, it's up to you and your team to manage, update, and replace each component as needed [10].

Examples of SaaS, PaaS and IaaS

Platform Type	Common Examples
SaaS	Google Workspace, Dropbox, Salesforce, Cisco WebEx, Concur, GoToMeeting
PaaS	AWS Elastic Beanstalk, Windows Azure, Heroku, Force.com, Google App Engine, Apache Stratos, OpenShift
IaaS	DigitalOcean, Linode, Rackspace, Amazon Web Services (AWS), Cisco Metapod, Microsoft Azure, Google Compute Engine (GCE)

Figure 10

Cloud Automation

Automation is the use of technology to perform tasks with reduced human assistance.

- Accelerate the processes and also scale the environment
- Build continuous integration, delivery and deployment
- IT / Business / Industry Automation
- Robotic Process Automation
- Artificial Intelligence
- Machine Learning / Deep Learning

Hybrid and multicloud environments add an additional layer of complexity to the overall infrastructure, network, application, and user administration.

IT teams need to manage both on-site and cloud-based environments, often using specialized management tools for each. As a result, it can be nearly impossible to effectively maintain, track, scale, and secure resources and applications by hand.

Automation can unite hybrid and multicloud management under a single set of processes and policies to improve consistency, speed and scalability [11]

Below are the Cloud Processes which can be automated

1. Scale multiclouds
2. Integrate hybrid clouds

Conclusions

Cloud infrastructure can be managed more efficiently than traditional physical infrastructure, which normally requires some components to be procured and assembled to support an application. Its scalability and flexibility make it suitable for enterprise computing. DevOps teams can deploy infrastructure programmatically as part of an application's code using cloud infrastructure.

Cloud governance is the process of defining, implementing, and monitoring a framework of policies that facilitate consistent performance of cloud services and systems. As cloud environments can quickly scale beyond manual control capabilities, automation makes efficient governance possible. With a unified automation platform, IT teams can optimize infrastructure and resource usage, maintain business continuity, and enforce compliance across an organization. This needs to be governed efficiently [12].

References

- [1] [Introduction: Cloud Infrastructure](#)
- [2] [Cloud Computing](#)
- [3] [Components of Cloud Infrastructure](#)
- [4] [Necessity to build Cloud Infrastructure](#)
- [5] [Benefits of using Cloud Infrastructure](#)
- [6] [Challenges to be considered when using a cloud infrastructure](#)
- [7] [Cloud Computing Services](#)
- [8] [Cloud Management](#)
- [9] [Cloud Security Services](#)
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- [10] [SaaS vs PaaS vs IaaS](#)

[11] [Cloud Automation](#)

[12] [Conclusions: Cloud Infrastructure](#)