



Cloud Computing

1. Define cloud computing and attributes for delivering computing services.

Definition

Cloud computing is providing different IT services to customers over the Internet. It is the ability to deliver computing service over the Internet to the end-users on-demand or on a pay-as-you-go basis.

Attributes

- Cloud computing uses Internet technologies to offer elastic services. The term elastic computing refers to the ability to dynamically acquire computing resources and support a variable workload. A cloud service provider maintains a massive infrastructure to support elastic services.
- The resources used for these services can be metered and the users can be charged only for the resources they use.
- Maintenance and security are ensured by service providers.
- Economy of scale allows service providers to operate more efficiently due to specialization and centralization.
- Cloud computing is cost-effective due to resource multiplexing; lower costs for the service provider are passed on to the cloud users.
- The application data is stored closer to the site where it is used in a device and location independent manner; potentially, this data storage strategy increases reliability and security and, at the same time, it lowers communication costs.

2. Discuss network-centric computing and network-centric content.

Network-centric Computing

- Net-Centric Computing (NCC) is a distributed environment where applications and data are downloaded from servers and exchanged with peers across a network. Net-centric Computing focuses on large-scale distributed computing systems and applications that communicate through open, wide-area networks like the Internet.
- Information processing can be done more efficiently on large farms of computing and storage systems accessible via the Internet. Ex:
 - **Grid computing** – targeted primarily at scientific computing.
 - **Utility computing** – targeted at enterprise computing.
- The focus of utility computing is on the business model for providing computing services; it often requires a cloud-like infrastructure.
- Network-centric computing refers to an emerging technology architecture and an evolutionary stage of client/server computing. It is a common architecture built on open standards that supports in different ways for different people to collaborate and to reach different information sources.
- Cloud computing is a path to utility computing embraced by major IT companies including: Amazon, HP, IBM, Microsoft, Oracle, and others.

Network-centric Content

- The term *content* refers to any type or volume of media, be it static or dynamic, monolithic or modular, live or stored, produced by aggregation, or mixed.
- The creation and consumption of audio and visual content is likely to transform the Internet to support increased quality in terms of resolution, frame rate, color depth, stereoscopic information.

3. Explain peer-to-peer systems.

Peer-to-peer (P2P) computing or networking is a distributed application architecture that partitions tasks or workloads between peers. Peers are equally privileged, equipotent participants in the application. They are said to form a peer-to-peer network of nodes.

Peers make a portion of their resources, such as processing power, disk storage or network bandwidth, directly available to other network participants, without the need

for central coordination by servers or stable hosts. Peers are both suppliers and consumers of resources, in contrast to the traditional client–server model in which the consumption and supply of resources is divided.

P2P systems exploit the network infrastructure to provide access to distributed computing resources.

Properties

- They require a minimally dedicated infrastructure, since resources are contributed by the participating systems.
- They are highly decentralized.
- They are scalable; the individual nodes are not required to be aware of the global state.
- They are resilient to faults and attacks.

4. Explain different types of clouds with examples.

Private Cloud

Private cloud refers to a cloud deployment model operated exclusively to a single organization. It provides computing services to a private internal network and selected users, instead of the public in general.

Eg: HP Data Centers, Elastra-private cloud, Ubuntu, etc.

Public Cloud

In this, the business rents the services that are required and pays for what is utilized on-demand. The resources are owned, maintained & operated by a third-party cloud service provider, and delivered over the internet.

Eg: AWS, GCP, Microsoft Azure, etc.

Community Cloud

Community clouds are distributed systems created by integrating the services of different clouds to address the specific needs of an industry, a community, or a business sector.

In the community cloud, the infrastructure is shared between organizations that have shared concerns or tasks. The cloud may be managed by an organization or a third

party.

Ex: Our government organization within India may share computing infrastructure in the cloud to manage data.

Hybrid Cloud

A hybrid cloud is a heterogeneous distributed system formed by combining facilities of public cloud and private cloud. For this reason, they are also called

heterogeneous clouds.

A major drawback of private deployments is the inability to scale on-demand and efficiently address peak loads. Here public clouds are needed. Hence, a hybrid cloud takes advantage of both public and private clouds.

Ex: Implementing database using on-premise private servers and using third party cloud service providers like AWS as load balancing or computing solutions.

5. Discuss the success and failure of cloud computing.

Advantages

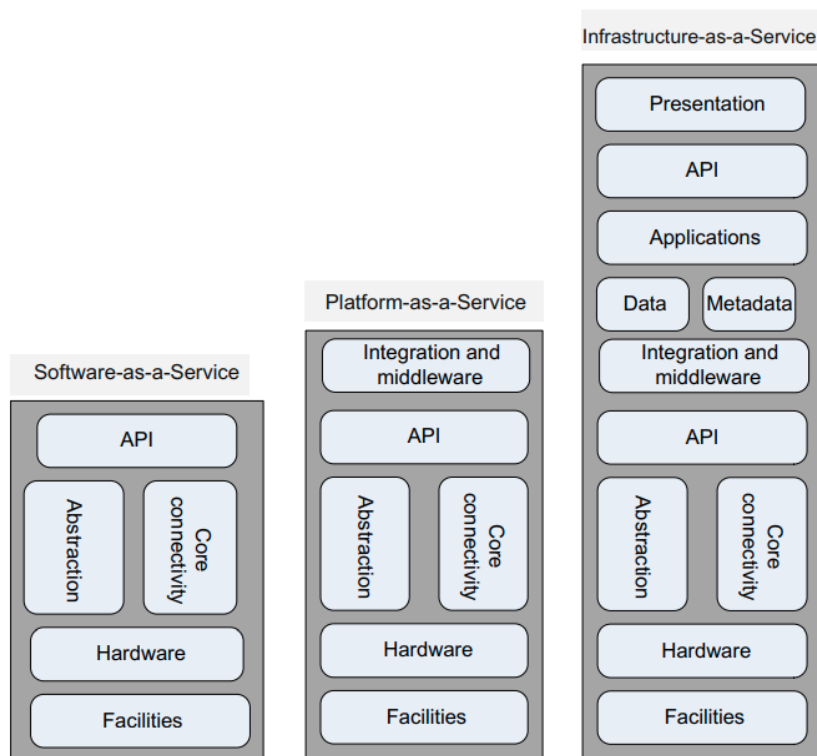
- **Flexibility:** Remote cloud servers offer almost unlimited bandwidth and storage space, which allows businesses to instantly scale up and down their capacities to support growth and cope when website traffic increases. This removes the need to purchase, configure and install equipment on-site.
- **Business Continuity:** By investing in cloud computing, businesses can guarantee reliable disaster recovery and backup solutions without the hassle of setting them up on a physical device.
- **Cost Efficiency:** The most significant advantage of cloud computing is the IT operational cost savings. Using remote servers removes the need for in-house storage equipment and application requirements, as well as overhead costs such as software updates, management, and data storage.
- **Scalability and Performance:** Cloud technology is designed to be scaled to meet a business's changing IT requirements. As a company grows, it is inevitable that more storage space and bandwidth will be required to cope with increasing traffic to the website. Cloud servers can be deployed automatically to help businesses scale up and down and ensure optimum performance under heavy loads.

- **Automatic Software Updates:** Many cloud service providers offer regular system updates to ensure IT requirements are consistently met. They ensure round-the-clock maintenance of cloud servers – including security updates.

Disadvantages

- **Requires good speed internet with good bandwidth:** To access your cloud services, you need to have a good internet connection always with good bandwidth to upload or download files to/from the cloud
- **Downtime:** Since the cloud requires high internet speed and good bandwidth, there is always a possibility of service outage, which can result in business downtime. Today, no business can afford revenue or business loss due to downtime or slow down from an interruption in critical business processes.
- **Limited control of infrastructure:** Since you are not the owner of the infrastructure of the cloud, hence you don't have any control or have limited access to the cloud infra.
- **Restricted or limited flexibility:** The cloud provides a huge list of services, but consuming them comes with a lot of restrictions and limited flexibility for your applications or developments. Also, platform dependency or 'vendor lock-in' can sometimes make it difficult for you to migrate from one provider to another.
- **Ongoing costs:** Although you save your cost of spending on whole infrastructure and its management, on the cloud, you need to keep paying for services as long as you use them. But in traditional methods, you only need to invest once.

6. With a neat diagram explain cloud computing delivery models and services.



There are three delivery models: SaaS, PaaS, and IaaS.

Software as a Service (SaaS)

Software as a Service provides you with a completed product that is run and managed by the service provider. In most cases, people referring to Software as a Service are referring to end-user applications. With a SaaS offering you do not have to think about how the service is maintained or how the underlying infrastructure is managed; you only need to think about how you will use that particular piece of software. A common example of a SaaS application is web-based email where you can send and receive email without having to manage feature additions to the email product or maintaining the servers and operating systems that the email program is running on.

Platform as a Service (PaaS)

Platforms as a service remove the need for organizations to manage the underlying infrastructure (usually hardware and operating systems) and allow you to focus on the deployment and management of your applications. This helps you be more efficient as you don't need to worry about resource procurement, capacity planning, software maintenance, patching, or any of the other undifferentiated heavy lifting involved in running your application.

Infrastructure as a Service (IaaS)

Infrastructure as a Service, sometimes abbreviated as IaaS, contains the basic building blocks for cloud IT and typically provide access to networking features, computers (virtual or on dedicated hardware), and data storage space. Infrastructure as a Service provides you with the highest level of flexibility and management control over your IT resources. Services offered by this delivery model include: server hosting, web servers, storage, computing hardware, operating systems, virtual instances, load balancing, Internet access, and bandwidth provisioning.

7. Discuss ethical issues encountered in cloud computing.

Cloud computing is based on a paradigm shift with profound implications for computing ethics. The main elements of this shift are:

- The control is relinquished to third-party services.
- The data is stored on multiple sites administered by several organizations.
- Multiple services interoperate across the network.

Unauthorized access, data corruption, infrastructure failure, and service unavailability are some of the risks related to relinquishing the control to third-party services; moreover, whenever a problem occurs, it is difficult to identify the source and the entity causing it.

The complex structure of cloud services can make it difficult to determine who is responsible in case something undesirable happens. In a complex chain of events or systems, many entities contribute to an action, with undesirable consequences.

Identity fraud and theft are made possible by the unauthorized access to personal data in circulation and by new forms of dissemination through social networks, which could also pose a danger to cloud computing.

Cloud service providers have already collected petabytes of sensitive personal information stored in data centers around the world. The acceptance of cloud computing therefore will be determined by privacy issues addressed by these companies and the countries where the data centers are located.

8. Explain cloud vulnerabilities.

Clouds are affected by malicious attacks and failures of the infrastructure. Such events can affect Internet domain name servers and prevent access to a cloud or can directly affect the clouds.

- **Misconfigured Cloud Storage:** Cloud storage is a rich source of stolen data for cybercriminals. Despite the high stakes, organizations continue to make the mistake of misconfiguration of cloud storage which has cost many companies greatly. According to a report, nearly 70 million records were stolen or leaked in 2018 due to misconfigured cloud storage buckets.
- **Insecure APIs:** Application user interfaces (APIs) are intended to streamline cloud computing processes. However, if left insecure, APIs can open lines of communications for attackers to exploit cloud resources.
- **Poor Access Management:** Improper access management is perhaps the most common cloud computing security risk. When companies are not aware of how their employees are using cloud computing services, they could lose control of their data assets and ultimately become vulnerable to breaches and insider security threats.

Such events can affect the Internet domain name servers and prevent access to a cloud or can directly affect the clouds:

- In 2009, Google was the target of a denial of service attack which took down Google News and Gmail for several days.
- In 2012 lightning caused a prolonged down time at Amazon

9. Discuss the challenges faced by cloud computing.



Same as answer 5, disadvantages.