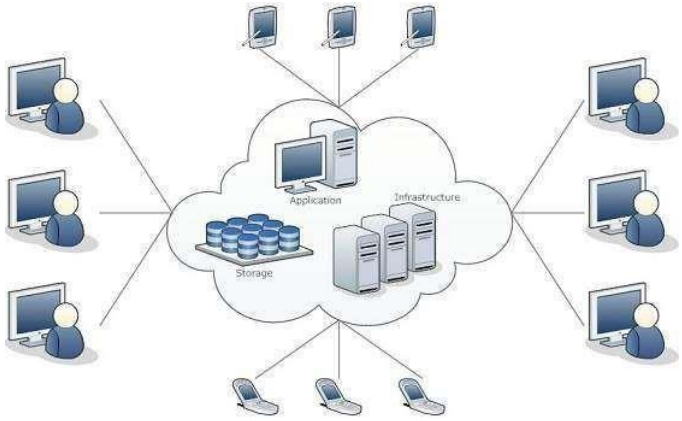
What is Cloud?

- The term Cloud refers to a Network or Internet. In other words, we can say that Cloud is something, which is present at remote location. Cloud can provide services over public and private networks, i.e., WAN, LAN .
- Applications such as e-mail, web conferencing, customer relationship management (CRM) execute on cloud.

What is Cloud Computing?

- Cloud Computing refers to manipulating, configuring, and accessing the hardware and software resources remotely. It offers online data storage, infrastructure, and application.
- Cloud computing refers to both the applications delivered as services over the Internet and the hardware and system software in the datacenters that provide those services.
- Cloud computing offers platform independency, as the software is not required



to be installed locally on the PC. Hence, the Cloud Computing is making our business applications mobile and collaborative.

- Cloud computing is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.

Benefits of Cloud Computing:-

Cloud Computing has numerous advantages. Some of them are listed below -

i. Low Cost: To run cloud technology, users don't require high power computer & technology as because the application will run on the cloud and not on users' PC. Itonly required internet connectivity.

ii. Storage capacity: The Cloud storage capacity is unlimited & generally offers a

hugestorage capacity of 2000-3000 GBs or more based on the requirement.

iii. Low cost of IT infrastructure: As discussed earlier, the investment will be less if anorganization uses Cloud technology; even the IT staffs and server engineers are also not required.

iv. Increase computing power: Cloud servers have a very high-capacity of running andprocessing tasks as well as the processing of applications.

v. Reduce Software Costs: Cloud minimizes the software costs as users don't need topurchase software for organizations or every computer.

Characteristics Of Cloud Computing:-

1. On Demand Self Service

Cloud Computing allows the users to use web services and resources on demand. Onecan logon to a website at any time and use them.

2. Broad Network Access

Since cloud computing is completely web based, it can be accessed from anywhere andat any time.

3. Resource Pooling

Cloud computing allows multiple tenants to share a pool of resources. One can share single physical instance of hardware, database and basic infrastructure.

4. Rapid Elasticity

It is very easy to scale the resources vertically or horizontally at any time. Scaling ofresources means the ability of resources to deal with increasing or decreasing demand.

The resources being used by customers at any given point of time are automaticallymonitored.

5. Measured Service

In this service cloud provider controls and monitors all the aspects of cloud service.Resource optimization, billing, and capacity planning etc. depend on it.

Distributed System?

A distributed system is a collection of independent computers that appear to the users of the system as a single coherent system. These computers or nodes work together, communicate over a network, and coordinate their activities to achieve a common goal by sharing resources, data, and tasks.

common distributed system architectures:

- **Client-Server Architecture:**
  - In this setup, servers provide resources or services, and clients request them. Clients and servers communicate over a network.
  - **Examples**: Web applications, where browsers (clients) request pages from web servers.
- **Peer-to-Peer (P2P) Architecture:**
  - Each node, or "peer," in the network acts as both a client and a server, sharing resources directly with each other.
  - **Examples**: File-sharing networks like BitTorrent, where files are shared between users without a central server.
- **Three-Tier Architecture:**
  - This model has three layers: presentation (user interface), application (business logic), and data (database). Each layer is separated to allow easier scaling and maintenance.
  - **Examples**: Many web applications use this to separate user interfaces, logic processing, and data storage.
- **Microservices Architecture:**
  - The application is split into small, independent services, each handling specific functions. These services communicate over a network, often using REST APIs or messaging.
  - **Examples**: Modern web applications like Netflix or Amazon, where different services handle user accounts, orders, and recommendations independently.
- **Service-Oriented Architecture (SOA):**
  - Similar to microservices, SOA organizes functions as services. However, SOA typically uses an enterprise service bus (ESB) to manage communication between services.
  - **Examples**: Large enterprise applications in finance or government, where different services handle various aspects of business processes.
- **Event-Driven Architecture:**
  - Components interact by sending and responding to events rather than direct requests. An event triggers specific actions or processes in various parts of the system.
  - **Examples**: Real-time applications like IoT systems, where sensors trigger actions based on detected events.

Example of a Distributed System

Any social media can have its Centralized Computer Network as its Headquarters and computer systems that can be accessed by any user and using their services will be the Autonomous Systems in the Distributed System Architecture.

- **Distributed System Software:** This Software enables computers to coordinate their activities and to share the resources such as Hardware, Software, Data, etc.
- **Database:** It is used to store the processed data that are processed by each Node/System of the Distributed systems that are connected to the Centralized network.

Characteristics of Distributed System

- **Resource Sharing:** It is the ability to use any Hardware, Software, or Data anywhere in the System.
- **Openness:** It is concerned with Extensions and improvements in the system (i.e., How openly the software is developed and shared with others)
- **Concurrency:** It is naturally present in Distributed Systems, that deal with the same activity or functionality that can be performed by separate users who are in remote locations. Every local system has its independent Operating Systems and Resources.
- **Scalability:** It increases the scale of the system as a number of processors communicate with more users by accommodating to improve the responsiveness of the system.
- **Fault tolerance:** It cares about the reliability of the system if there is a failure in Hardware or Software, the system continues to operate properly without degrading the performance of the system.
- **Transparency:** It hides the complexity of the Distributed Systems to the Users and Application programs as there should be privacy in every system.

Advantages of Distributed System

Below are some of the advantages of Distributed System:

- **Scalability:** Distributed systems can easily grow by adding more computers (nodes), allowing them to handle increased demand without significant reconfiguration.
- **Reliability and Fault Tolerance:** If one part of the system fails, others can take over, making distributed systems more resilient and ensuring services remain available.
- **Performance:** Workloads can be split across multiple nodes, allowing tasks to be completed faster and improving overall system performance.
- **Resource Sharing:** Distributed systems allow resources like data, storage, and computing power to be shared across nodes, increasing efficiency and reducing costs.
- **Geographical Distribution:** Since nodes can be in different locations, distributed systems can serve users globally, providing faster access to resources based on location.

Disadvantages of Distributed System

Below are some of the disadvantages of Distributed System:

- Relevant Software for Distributed systems does not exist currently.
- Security possesses a problem due to easy access to data as the resources are shared to multiple systems.
- Networking Saturation may cause a hurdle in data transfer i.e., if there is a lag in the network then the user will face a problem accessing data.
- In comparison to a single user system, the database associated with distributed systems is much more complex and challenging to manage.
- If every node in a distributed system tries to send data at once, the network may become

overloaded.

Use cases of Distributed System

- **Finance and Commerce:** Amazon, eBay, Online Banking, E-Commerce websites.
- **Information Society:** Search Engines, Wikipedia, Social Networking, Cloud Computing.
- **Cloud Technologies:** AWS, Salesforce, Microsoft Azure, SAP.
- **Entertainment:** Online Gaming, Music, youtube.
- **Healthcare:** Online patient records, Health Informatics.
- **Transport and logistics:** GPS, Google Maps.

Web 1.0, Web 2.0, and Web 3.0

Web 1.0 was all about **fetching** and **reading** information. **Web 2.0** is all about **reading**, **writing**, **creating**, and **interact**ing with the end user. It was famously called the participative social web. **Web 3.0** is the third generation of the **World Wide Web**, and is a vision of a **decentralized** web which is currently a work in progress. It is all about **reading**, **writing**, and **owning**.

What is Web 1.0?

Web 1.0 refers to the first stage of the World Wide Web evolution. Earlier, there were only a few content creators in Web 1.0 with a huge majority of users who are consumers of content. Personal web pages were common, consisting mainly of static pages hosted on ISP-run **web servers**, or free **web hosting services**.

In Web 1.0 advertisements on websites while surfing the internet are banned. Also, in Web 1.0, **Ofoto** is an online digital photography website, on which users could store, share, view, and print digital pictures. Web 1.0 is a **content delivery network** (**CDN**) that enables the showcase of the piece of information on the websites. It can be used as a personal website. It costs the user as per pages viewed. It has directories that enable users to retrieve a particular piece of information. The era of Web 1.0 was roughly from 1991 to 2004.

Four Design Essentials of a Web 1.0 Site Include:

- *Static pages.*
- *Content is served from the server's file system.*
- *Pages built using Server Side Includes or* ***Common Gateway Interface*** *(CGI).*
- *Frames and Tables are used to position and align the elements on a page.*

Features of the Web 1.0

- *Easy to connect static pages with the system via hyperlinks*
- *Supports elements like frames and tables with HTML 3.2*
- *Also has graphics and a GIF button*
- *Less interaction between the user and the server*
- *You can send* ***HTML*** *forms via mail*
- *Provides only a one-way publishing medium*

What is Web 2.0?

2004 When the word Web 2.0 become famous due to the First Web 2.0 conference (later known as the Web 2.0 summit) held by Tim O'Reilly and Dale Dougherty, the term was coined by Darcy DiNucci in 1999. Web 2.0 refers to worldwide websites which highlight user-generated content, usability, and interoperability for end users. Web 2.0 is also called the participative

social web. It does not refer to a modification to any technical specification, but to modify the way Web pages are designed and used. The transition is beneficial, but it does not seem that when the changes occur. Interaction and collaboration with each other are allowed by Web 2.0 in a social media dialogue as the creator of user-generated content in a virtual community. Web 2.0 is an enhanced version of Web 1.0.

Web browser technologies are used in Web 2.0 development, and it includes **AJAX** and JavaScript frameworks. Recently, AJAX and **JavaScript** frameworks have become very popular means of creating web 2.0 sites.

Features of the Web 2.0

- *Free sorting of information permits users to retrieve and classify the information collectively.*
- *Dynamic content that is responsive to user input.*
- *Information flows between the site owner and site users using evaluation & online commenting.*
- *Developed APIs to allow self-usage, such as by a software application.*
- *Web access leads to concerns different, from the traditional Internet user base to a wider variety of users.*

Usage of Web 2.0

The social Web contains several online tools and platforms where people share their perspectives, opinions, thoughts, and experiences. Web 2.0 applications tend to interact much more with the end user. As such, the end-user is not only a user of the application but also a participant in these 8 tools mentioned below:

- **Podcasting**
- **Blogging**
- **Tagging**
- **Curating with RSS**
- **Social bookmarking**
- **Social networking**
- **Social media**
- **Web content voting**

What is Web 3.0?

It refers to the evolution of web utilization and interaction which includes altering the Web into a database, with the integration of **DLT** (Distributed Ledger Technology **blockchain** is an example) and that data can help to make Smart Contracts based on the needs of the individual. It enables the up-gradation of the backend of the web, after a long time of focusing on the **front-end** (Web 2.0 has mainly been about AJAX, tagging, and other front-end user-experience innovation). Web 3.0 is a term that is used to describe many evolutions of web usage and interaction among several paths. In this, data isn't owned but instead shared but still is, where services show different views for the same web / the same data.

Features of the Web 3.0

- **Semantic Web:** The succeeding evolution of the Web involves the Semantic Web. The semantic web improves web technologies in demand to create, share and connect content through search and analysis based on the capability to comprehend the meaning of words, rather than on keywords or numbers.
- **Artificial Intelligence:** Combining this capability with **natural language processing,** in Web 3.0, computers can distinguish information like humans to provide faster and more

relevant results. They become more intelligent to fulfill the requirements of users.

- **3D Graphics:** The three-dimensional design is being used widely in websites and services in Web 3.0. *Museum guides, computer games, e-commerce, geospatial contexts*, etc. are all examples that use 3D graphics.
- **Connectivity:** With Web 3.0, information is more connected thanks to semantic metadata. As a result, the user experience evolves to another level of connectivity that leverages all the available information.
- **Ubiquity:** Content is accessible by multiple applications, every device is connected to the web, and the services can be used everywhere.
- **DLT and Smart Contracts:** With the help of DLT, we can have a virtually impossible-to-hack database from which one can have value to their content and things they can own virtually, this is the technology that enables a trustless society through the integration of smart contracts which does not need to have a middle man to be a guarantor to make that contract occur on certain cause its based on data from that DLT. It's a powerful tool that can make the world a far better place and generate more opportunities for everyone on the internet.

Differences Between the Web 1.0, Web 2.0, and Web 3.0

S. No.	Web 1.0	Web 2.0	Web 3.0
1.	Mostly Read-Only	Wildly Read-Write	Portable and Personal
2.	Company Focus	Community Focus	Individual Focus
3.	Home Pages	Blogs / Wikis	Live-streams / Waves
4.	Owning Content	Sharing Content	Consolidating Content
5.	WebForms	Web Applications	Smart Applications
6.	Directories	Tagging	User behavior
7.	Page Views	Cost Per Click	User Engagement
8.	Banner Advertising	Interactive Advertising	Behavioral Advertising
9.	Britannica Online	Wikipedia	The Semantic Web
10.	HTML/Portals	XML / RSS	RDF / RDFS / OWL

S. No.	Web 1.0	Web 2.0	Web 3.0
11.	Data was not Focused.	Data of many was controlled by some mediatory.	Data was personalized and no use of mediatory.
12.	Information sharing is the goal.	Interaction is the goal.	Immersion is the goal.
13.	It connects information as its primary goal.	It aims to connect people.	Focuses on relating knowledge.
14.	Static websites	Introduction of web applications	Intelligent web-based functions and apps
15.	A simpler, more passive web.	An enhanced social Web	A semantic web exists.
16.	Web and File Servers, HTML, and Portals are technologies connected to Web 1.0.	AJAX, JavaScript, CSS, and HTML5 are examples of related technology.	Web 3.0 technologies include blockchain, artificial intelligence, and decentralized protocols.
17.	**Associated Technologies** • Web and File Servers • Search Engines (including AltaVista and Yahoo!) • E-mail accounts (Yahoo!, Hotmail) • Peer-to-Peer File Sharing (Napster, BitTorrent) and others.	**Associated Technologies** • Frameworks for Ajax and JavaScript • Microsoft.NET • Blogs • Wikis and others.	**Associated Technologies** • Searching Using Semantics • Databases of Information • Ontologies • Intelligent Digital Personal Assistants and others.

Parallel Computing :

It is the use of multiple processing elements simultaneously for solving any problem. Problems are broken down into instructions and are solved concurrently as each resource that has been applied to work is working at the same time.

Advantages of Parallel Computing over Serial Computing are as follows:

1. It saves time and money as many resources working together will reduce the time and cut potential costs.
2. It can be impractical to solve larger problems on Serial Computing.
3. It can take advantage of non-local resources when the local resources are finite.
4. Serial Computing 'wastes' the potential computing power, thus Parallel Computing makes better work of the hardware.

Types of Parallelism:

1. **Bit-level parallelism –**
   It is the form of parallel computing which is based on the increasing processor's size. It reduces the number of instructions that the system must execute in order to perform a task on large-sized data.
   Example: Consider a scenario where an 8-bit processor must compute the sum of two 16-bit integers. It must first sum up the 8 lower-order bits, then add the 8 higher-order bits, thus requiring two instructions to perform the operation. A 16-bit processor can perform the operation with just one instruction.
2. **Instruction-level parallelism –**
   A processor can only address less than one instruction for each clock cycle phase. These instructions can be re-ordered and grouped which are later on executed concurrently without affecting the result of the program. This is called instruction-level parallelism.
3. **Task Parallelism –**
   Task parallelism employs the decomposition of a task into subtasks and then allocating each of the subtasks for execution. The processors perform the execution of sub-tasks concurrently.
4. **Data-level parallelism (DLP) –**

Instructions from a single stream operate concurrently on several data – Limited by non-regular data manipulation patterns and by memory bandwidth

Why parallel computing?

- The whole real-world runs in dynamic nature i.e. many things happen at a certain time but at different places concurrently. This data is extensively huge to manage.
- Real-world data needs more dynamic simulation and modeling, and for achieving the same, parallel computing is the key.
- Parallel computing provides concurrency and saves time and money.
- Complex, large datasets, and their management can be organized only and only using parallel computing's approach.
- Ensures the effective utilization of the resources. The hardware is guaranteed to be used effectively whereas in serial computation only some part of the hardware was used and the rest rendered idle.
- Also, it is impractical to implement real-time systems using serial computing.

Applications of Parallel Computing:

- Databases and Data mining.
- Real-time simulation of systems.
- Science and Engineering.

- Advanced graphics, augmented reality, and virtual reality.

Limitations of Parallel Computing:

- It addresses such as communication and synchronization between multiple sub-tasks and processes which is difficult to achieve.
- The algorithms must be managed in such a way that they can be handled in a parallel mechanism.
- The algorithms or programs must have low coupling and high cohesion. But it's difficult to create such programs.
- More technically skilled and expert programmers can code a parallelism-based program well.

Difference between Parallel Computing and Distributed Computing:

S.NO	Parallel Computing	Distributed Computing
1.	Many operations are performed simultaneously	System components are located at different locations
2.	Single computer is required	Uses multiple computers
3.	Multiple processors perform multiple operations	Multiple computers perform multiple operations
4.	It may have shared or distributed memory	It have only distributed memory
5.	Processors communicate with each other through bus	Computer communicate with each other through message passing.
6.	Improves the system performance	Improves system scalability, fault tolerance and resource sharing capabilities

Difference between Cloud Computing and Distributed Computing :

S.No.	CLOUD COMPUTING	DISTRIBUTED COMPUTING
01.	Cloud computing refers to providing on demand IT resources/services like server, storage, database, networking, analytics, software etc. over internet.	Distributed computing refers to solve a problem over distributed autonomous computers and they communicate between them over a network.
02.	In simple cloud computing can be said as a computing technique that delivers	In simple distributed computing can be said as a computing technique which allows to

	hosted services over the internet to its users/customers.	multiple computers to communicate and work to solve a single problem.
03.	It is classified into 4 different types such as Public Cloud, Private Cloud, Community Cloud and Hybrid Cloud.	It is classified into 3 different types such as Distributed Computing Systems, Distributed Information Systems and Distributed Pervasive Systems.
04.	There are many benefits of cloud computing like cost effective, elasticity and reliable, economies of Scale, access to the global market etc.	There are many benefits of distributed computing like flexibility, reliability, improved performance etc.
05.	Cloud computing provides services such as hardware, software, networking resources through internet.	Distributed computing helps to achieve computational tasks more faster than using a single computer as it takes a lot of time.
06.	The goal of cloud computing is to provide on demand computing services over internet on pay per use model.	The goal of distributed computing is to distribute a single task among multiple computers and to solve it quickly by maintaining coordination between them.
07.	Some characteristics of cloud computing are providing shared pool of configurable computing resources, on-demand service, pay per use, provisioned by the Service Providers etc.	Some characteristics of distributed computing are distributing a single task among computers to progress the work at same time, Remote Procedure calls and Remote Method Invocation for distributed computations.
08.	Some disadvantage of cloud computing includes less control especially in the case of public clouds, restrictions on available services may be faced and cloud security.	Some disadvantage of distributed computing includes chances of failure of nodes, slow network may create problem in communication.