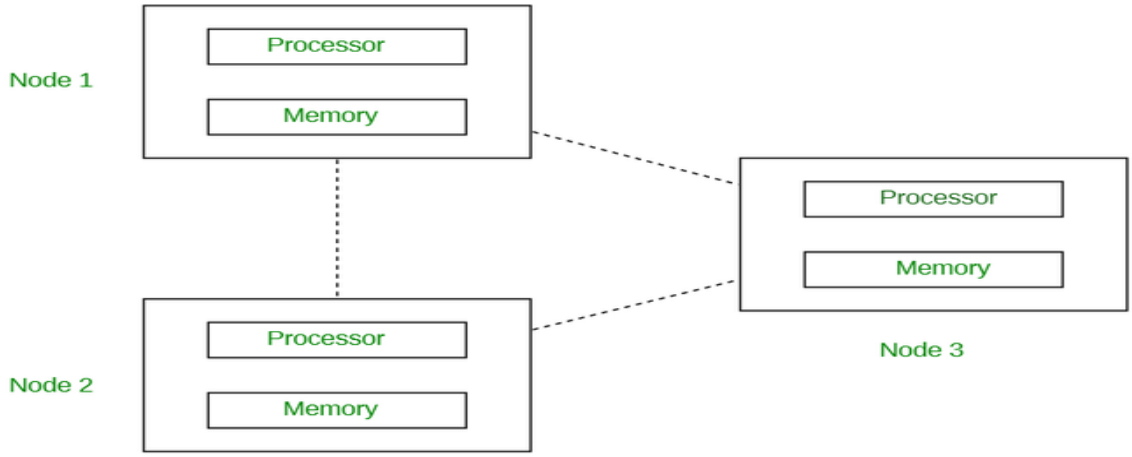
Computing Paradigms

1.Distributed Computing (Before Cloud Computing)

Distributed computing is a type of computing where **many computers work together** to solve **one big problem**.
The main idea is to **break the problem into smaller parts**, and then **each computer solves one part**.

All these computers are **connected through a network** and **communicate** with each other to share the results.



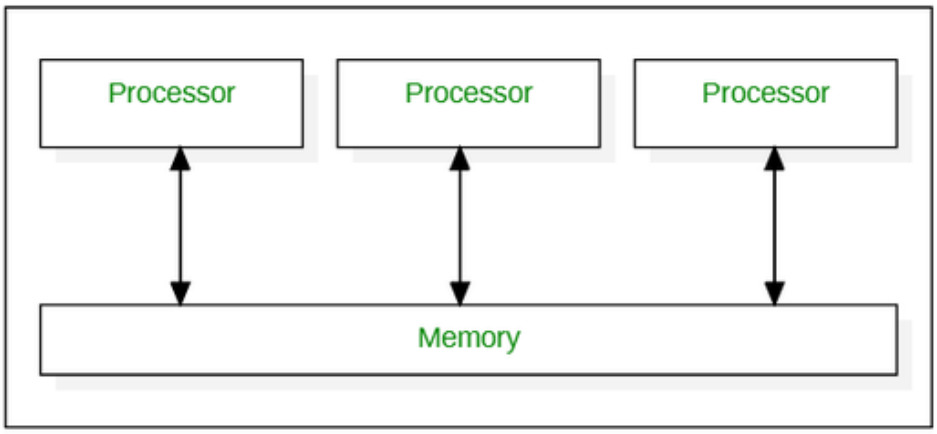
Key Points:

- Multiple computers work on the **same task**.
- The task is **divided into smaller problems**.
- Each system has its **own local memory**.
- Systems are connected and **share information over a network**.
- It helps in:
    - **Better performance**
    - **Higher efficiency**
    - **Fault tolerance** (if one system fails, others can still work)

2. Parallel Computing

Parallel computing is a method where **multiple processors** (inside one computer or system) work **at the same time** to solve a single problem.

The problem is split into smaller tasks, and each processor **runs one task at the same time**, which makes the work **faster**.



Key Points:

- All processors share the **same memory**.
- Tasks are done **simultaneously (in parallel)**.
- Mostly used in **high-speed computing**, like scientific simulations or weather forecasting.
- Goal: **Save time and increase processing speed**.
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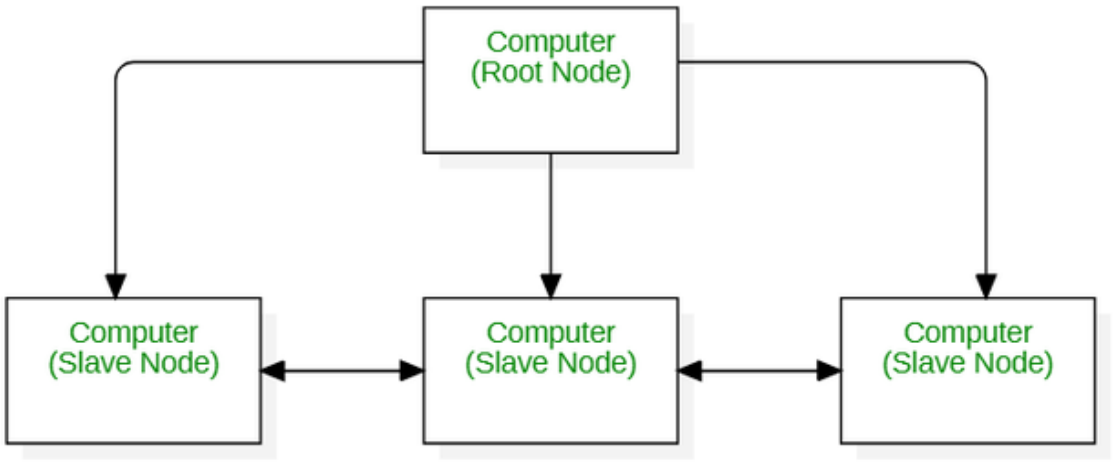
3. Cluster Computing

In **cluster computing**, a **group of computers** (called nodes) work together as a **single system**.

They are connected through a **local network** and managed together. If one computer fails, the others can **continue the work**.



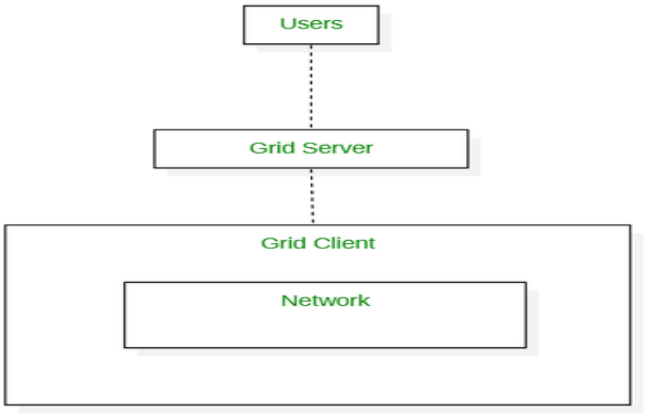
Key Points:

- Group of independent computers working as one.
- Used for **high availability and performance**.
- Common in **research labs**, **data centers**, and **enterprise computing**.
- Cost-effective compared to large mainframes.

4. Grid Computing

Grid computing connects computers from **different locations** to solve one problem. These systems can be **geographically far apart**.

It is like using unused computing power (CPU, memory) from many computers and combining them to do large tasks.



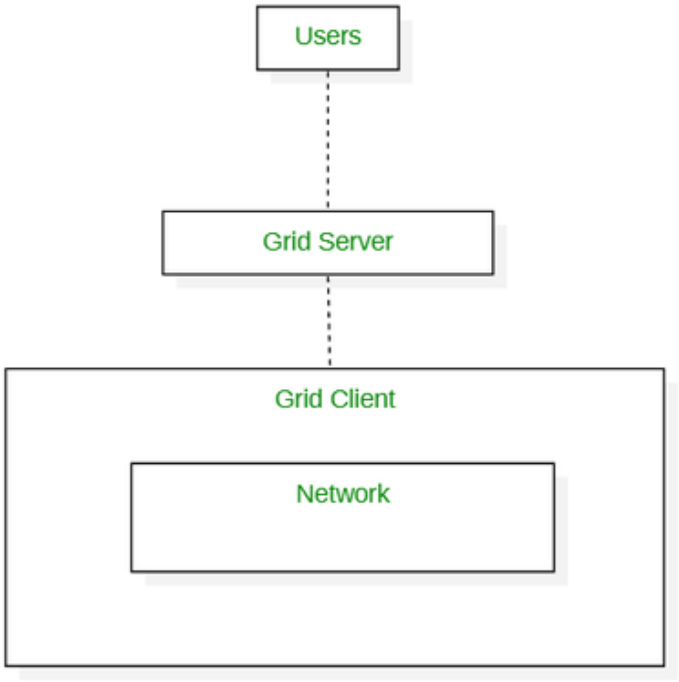
Key Points:

- Computers are located in **different places**.
- Resources are **shared**.
- Used in large-scale projects like **scientific research** and **data analysis**.
- Works like a virtual supercomputer.

5. Utility Computing

Utility computing is a model where users **pay for computing services** as they use them, just like electricity or water.

Instead of owning computers, you **rent computing power**, storage, or software from a service provider.



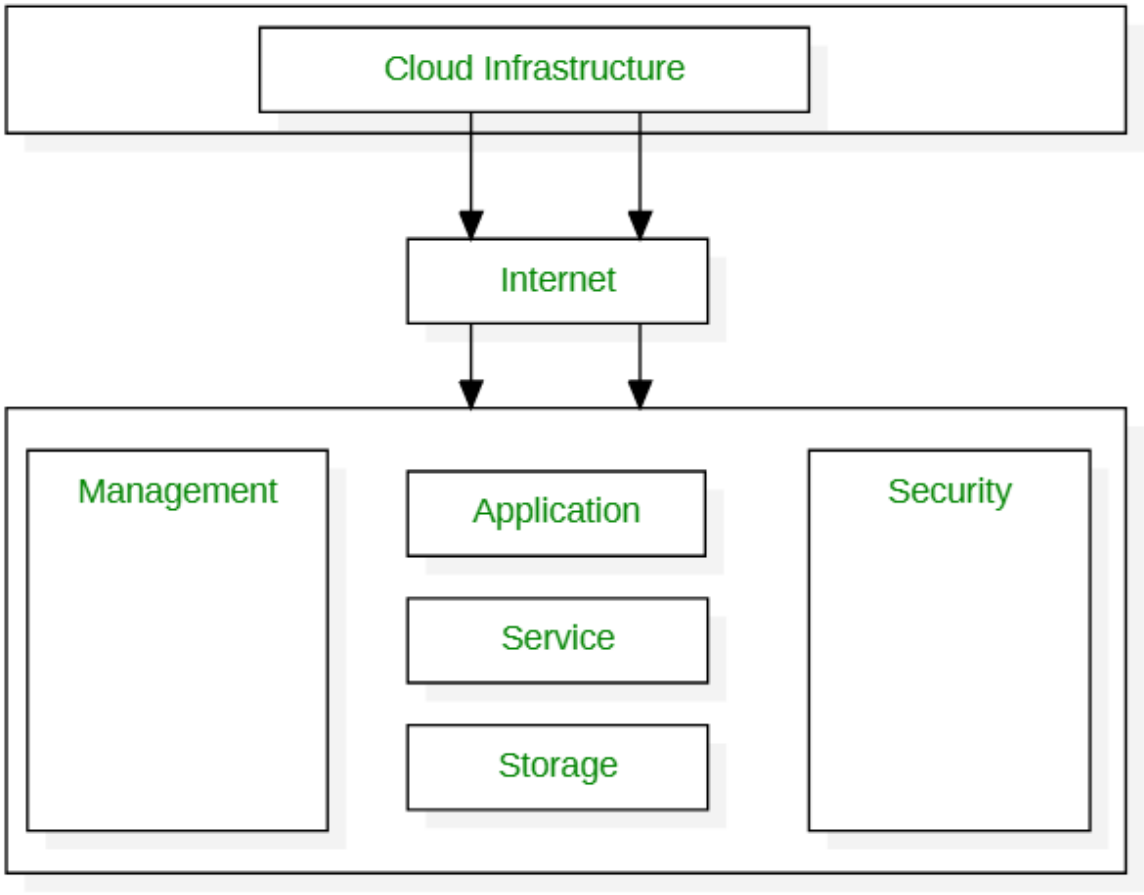
Key Points:

- **Pay-as-you-use** model.
- Reduces hardware costs.
- Resources are provided on-demand.
- Early form of cloud computing.

6. Cloud Computing

Cloud computing is the most modern computing paradigm. It allows users to **store, access, and process data** over the **internet** using remote servers.

Users don't need to worry about hardware, storage, or maintenance—everything is handled by **cloud providers** like AWS, Google Cloud, or Microsoft Azure.

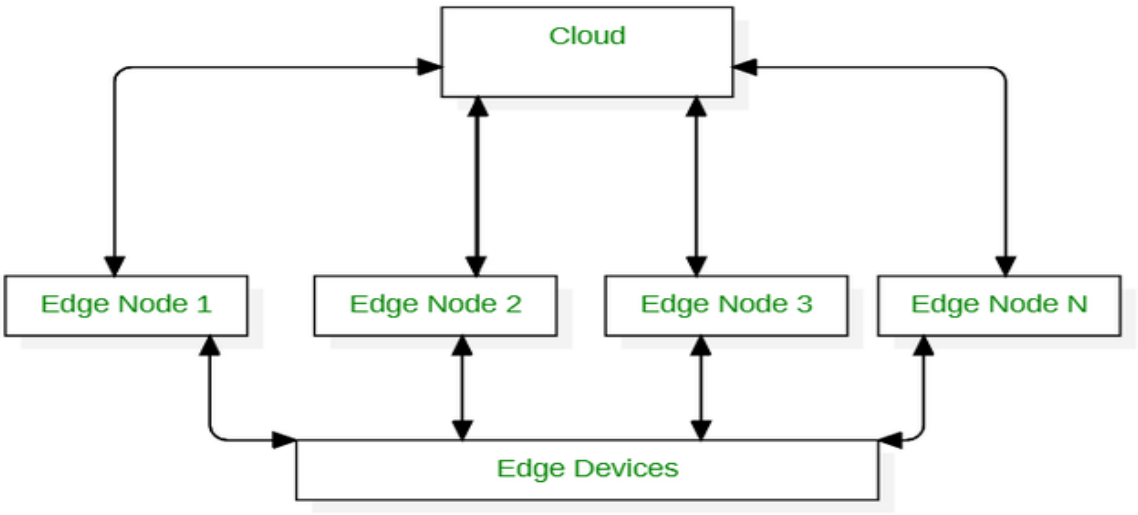


Key Points:

- Access services **anytime, anywhere** via the internet.
- Provides **scalability**, **flexibility**, and **cost efficiency**.
- Offers services like:
  - **IaaS** – Infrastructure as a Service
  - **PaaS** – Platform as a Service
  - **SaaS** – Software as a Service

7. Edge Computing

Edge computing is a type of computing where **data is processed closer to where it is created**, like on a **user's device**, **IoT device**, or a nearby **edge server** — instead of sending all the data to a faraway cloud server.



Why use Edge Computing?

To **reduce long-distance communication** between the user (client) and the cloud (server), which helps in:

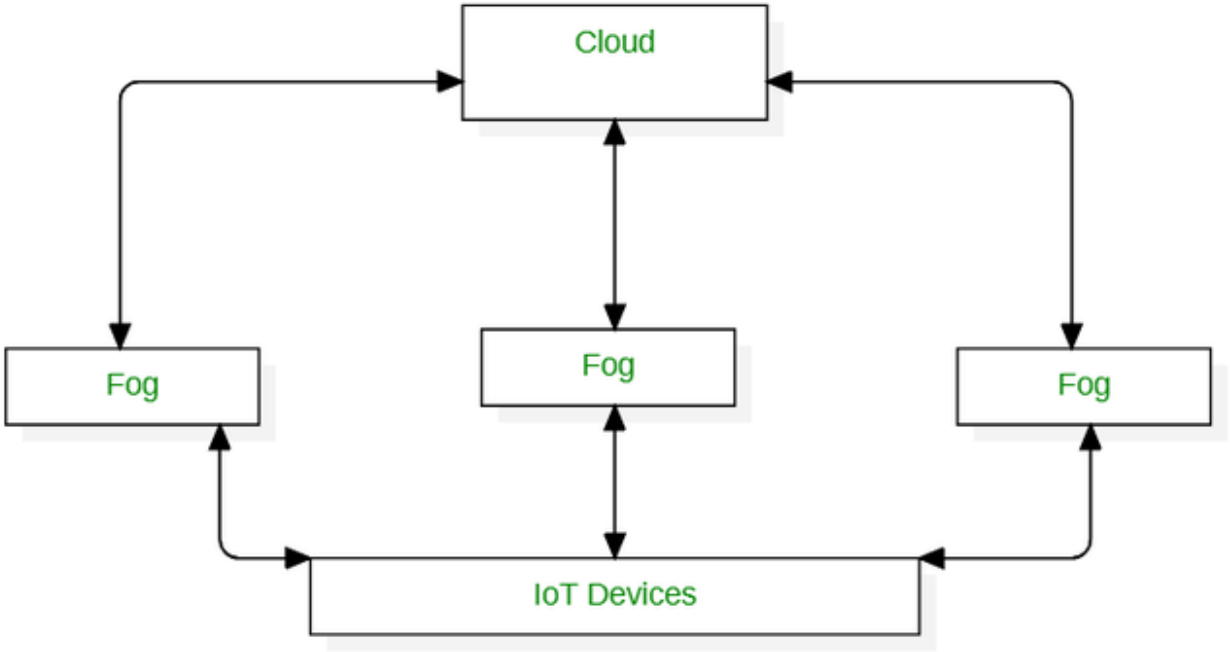
- **Faster response times**
- **Lower internet usage**
- **Better performance for real-time applications**

Goal:

To bring **computing and data processing near the source** (at the "edge" of the network), so that **interaction is quicker and smoother**.

8. Fog Computing

Fog computing is a type of computing that works **between the cloud and the devices that create data** (like sensors, IoT devices, etc.). It acts like a **middle layer** and is also called **"fogging"**.



What does it do?

Fog computing helps in **processing data closer to the user**, but not as close as edge devices — it's **in between the cloud and the edge**.

It allows users to place **resources, data, and apps** at locations that are **physically closer** to each other. This helps in:

- Faster processing
- Better network performance

Goal:

To **boost network efficiency** and provide **faster services** by reducing the amount of data sent all the way to the cloud.