Cloud Computing FUNDAMENTALS
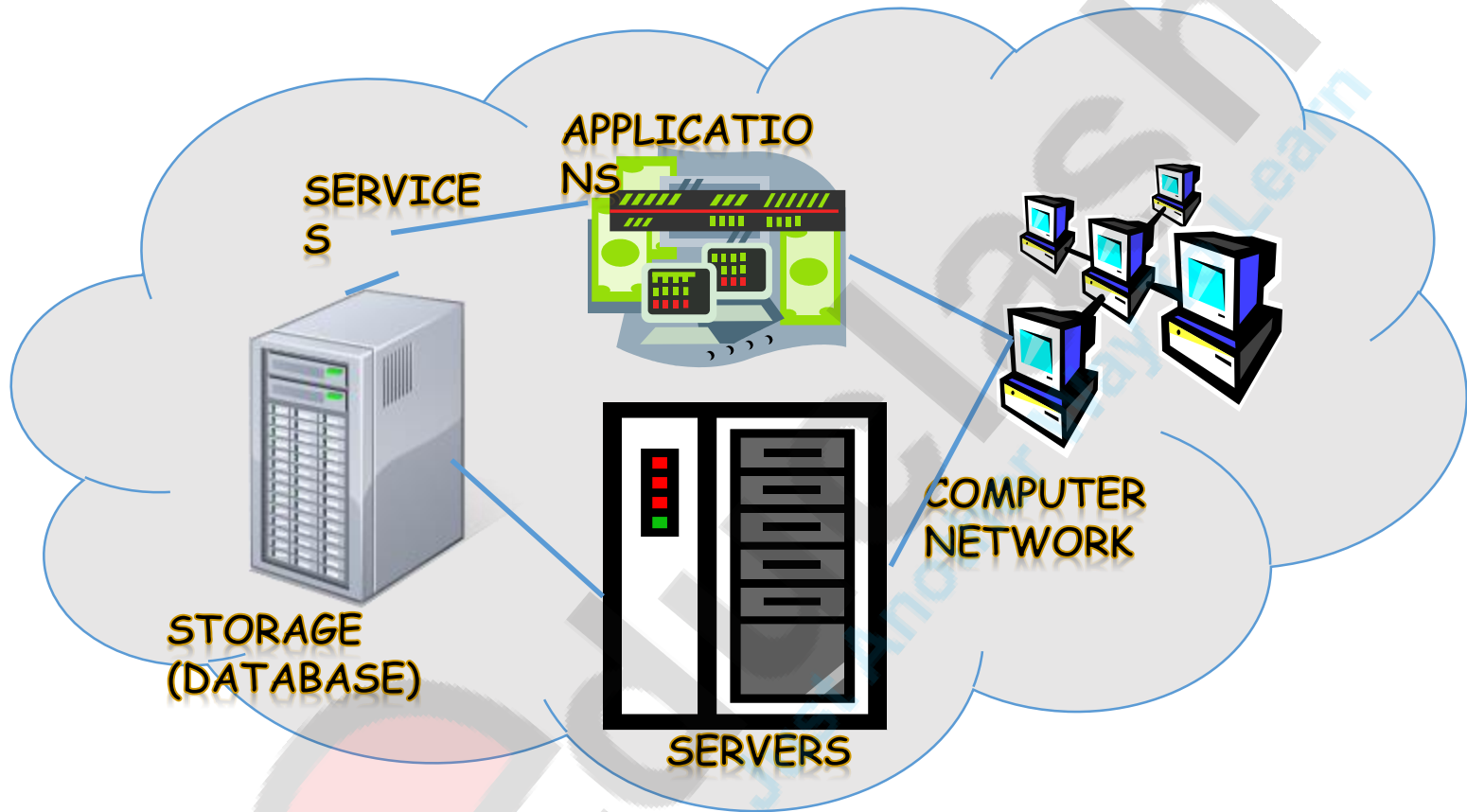
MODULE 9

What Is Cloud Computing?

- **Generally speaking, cloud computing can be thought of as anything that involves delivering hosted services over the Internet.**

- **According to NIST "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."**

What is Cloud Computing

- Shared pool of configurable computing resources
- On-demand network access
- Provisioned by the Service Provider

Evolution of Cloud Computing

- Client-Server Computing: Centralized Applications and Storage

- Peer-to-peer Computing: Sharing Resources

- Distributed Computing; Providing more Computing Power

- Collaborative Computing: Working as a Group

- Cloud Computing: The Next Step in Collaboration

Essential Characteristics

- *On-demand self-service*

  A consumer can unilaterally provision computing capabilities, such as server time and network storage, as needed automatically without requiring human interaction with each service provider.

- *Broad network access*

  Capabilities are available over the network and accessed through standard mechanisms that promote use by heterogeneous thin or thick client platforms (e.g., mobile phones, tablets, laptops, and workstations).

Characteristics

- *Resource pooling*

    The provider's computing resources are pooled to serve multiple consumers

    Resources can be dynamically assigned and reassigned according to customer demand

    Customer generally may not care where the resources are physically located but should be aware of risks if they are located offshore

Characteristics

- *Rapid elasticity*

    Capabilities can be expanded or released automatically (i.e., more cpu power, or ability to handle additional users)

    To the customer this appears seamless, limitless, and responsive to their changing requirements
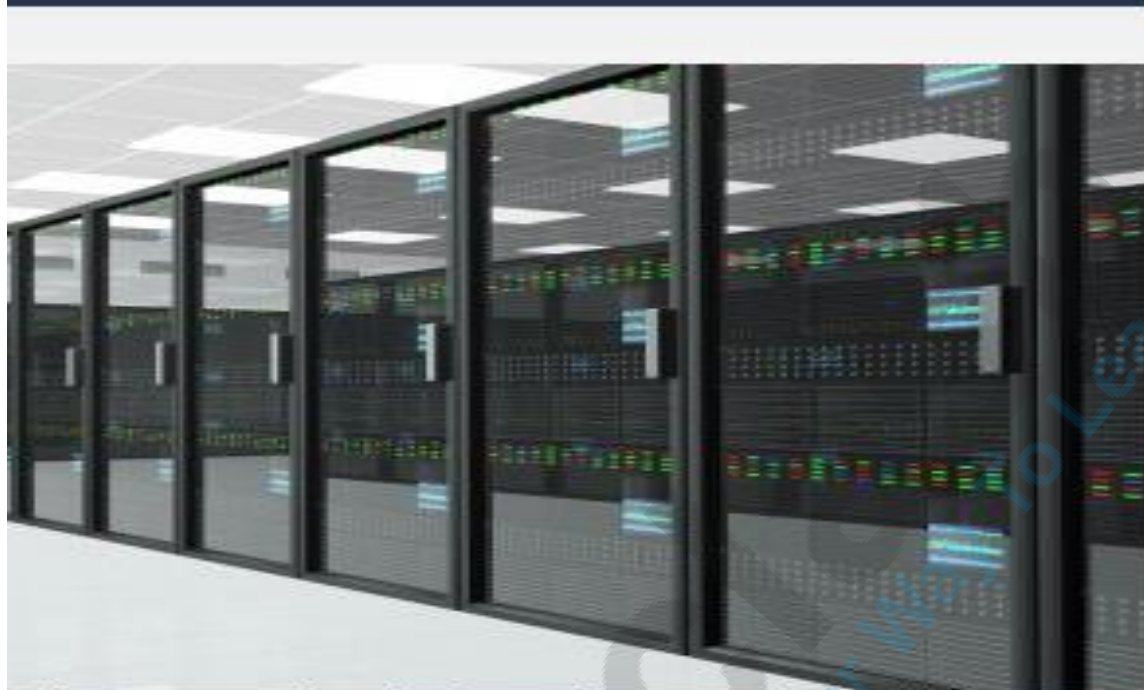
- *Measured service*

    Customers are charged for the services they use and the amounts

    There is a metering concept where customer resource usage can be monitored, controlled, and reported, providing transparency for both the provider and consumer of the utilized service

Cluster Computing

- Cluster computing is a form of computing in which a group of computers are linked together so that they can act like a single entity. There are a number of reasons for people to use cluster computers for computing tasks, ranging from an inability to afford a single computer with the computing capability of a cluster, to a desire to ensure that a computing system is always available.

Cluster computing is a form of computing in which a group of computers are linked together so they can work as a single entity.

Load balancing is used to manage a large incoming flow of incoming requests on a network.

Grid Computing

- **Grid computing** is the collection of **computer** resources from multiple locations to reach a common goal. Grids supports *Virtual Organizations.*

- *Virtual organizations (VOs)* are groups of researchers with similar scientific interests and requirements, who are able to work collaboratively with other members and/or share resources (e.g. data, software, expertise, CPU, storage space), regardless of geographical location.

Grid vs Cloud Computing

	Grid computing	**Cloud computing**
What?	Grids enable access to **shared** computing power and storage capacity from your desktop	Clouds enable access to **leased** computing power and storage capacity from your desktop
Who provides the service?	**Research** institutes and universities federate their services around the world ████████████████████	Large individual companies e.g. Amazon and **Microsoft** and at a smaller scale, institutes and organisations deploying ████████████████████
Who uses the service?	Research collaborations, called "Virtual Organisations", which bring togetherresearchers around the world working in the same field.	Small to medium commercial businesses or researchers with generic IT needs
Who pays for the service?	Governments - providers and users are usually publicly **FUNDED** ⬀ research organisations, ████████████████	The **cloud** provider pays for the computing resources; the user pays to use them
Where are the computing resources?	In computing centres distributed across different sites, countries and continents.	The cloud providers private data centres which are often centralised in a few locations with excellent network connections and cheap electrical power.

Why use them?	- You don`t need to buy or maintain your own large computer centre - You can complete **more** work more quickly and tackle more difficult problems. - You can share data with your distributed team in a secure way.	- You don`t need to buy or maintain your own personal computer centre - You can quickly access extra resources during peak work periods
How do they work?	Grids are an **open source** technology. Resource users and providers alike can understand and contribute to the management of their grid	Clouds are a **proprietary** technology. Only the resource provider knows exactly how their cloud manages data, **job** queues, security requirements and so on.
Benefits?	- **Collaboration:** grid offers a federated platform for distributed and collective work. - **Ownership :** resource providers maintain ownership of the resources they contribute to the grid - **Transparency:** the technologies used are open source, encouraging trust and transparency. - **Resilience:** grids are located at multiple sites, reducing the risk in case of a failure at one site that removes significant resources from the infrastructure.	- **Flexibility:** users can quickly outsource peaks of activity without long term commitment - **Reliability:** provider has **FINANCIAL** ⟳ incentive to guarantee service availability - **Ease of use:** relatively quick and easy for non-expert users to get started but setting up sophisticated virtual machines to support complex applications is more difficult.

Drawbacks?

- **Reliability:** grids rely on distributed services maintained by distributed staff, often resulting in inconsistency in reliability across individual sites, although the service itself is always available.
- **Complexity:** grids are complicated to build and use, and currently users require some level of expertise.
- **Commercial:** grids are generally only available for not-for-profit work, and for **proof of concept** in the commercial sphere

- **Generality:** clouds do not offer many of the specific high-level services currently provided by grid technology.
- **Security:** users with sensitive data may be reluctant to entrust it to external providers or to providers outside their borders.
- **Opacity:** the technologies used to guarantee reliability and safety of cloud operations are not made public.
- **Rigidity:** the cloud is generally located at a **single** site, which increases risk of complete cloud failure.

When?

The concept of grids was proposed in 1995. The Open science grid (OSG) started in 1995 The EDG (European Data Grid) project began in 2001.

In the late 1990`s Oracle and EMC offered early private cloud solutions . However the term cloud computing didn't gain prominence until 2007.

Advantages of Cloud Computing

- Lower computer costs:
  - You do not need a high-powered and high-priced computer to run cloud computing's web-based applications.
  - Since applications run in the cloud, not on the desktop PC, your desktop PC does not need the processing power or hard disk space demanded by traditional desktop software.
  - When you are using web-based applications, your PC can be less expensive, with a smaller hard disk, less memory, more efficient processor...
  - In fact, your PC in this scenario does not even need a CD or DVD drive, as no software programs have to be loaded and no document files need to be saved.

Advantages of Cloud Computing

- Improved performance:
  - With few large programs hogging your computer's memory, you will see better performance from your PC.
  - Computers in a cloud computing system boot and run faster because they have fewer programs and processes loaded into memory…

- Reduced software costs:
  - Instead of purchasing expensive software applications, you can get most of what you need for reduced costs
  - better than paying for similar commercial software
    - which alone may be justification for switching to cloud applications.

Advantages of Cloud Computing

- Instant software updates:
  - Another advantage to cloud computing is that you are no longer faced with choosing between obsolete software and high upgrade costs.
  - When the application is web-based, updates happen automatically
    - available the next time you log into the cloud.
  - When you access a web-based application, you get the latest version
    - without needing to pay for or download an upgrade.

- Unlimited storage capacity:
  - Cloud computing offers virtually limitless storage.
  - Your computer's current 1 Tbyte hard drive is small compared to the hundreds of Pbytes available in the cloud.

Advantages of Cloud Computing

- Increased data reliability:
  - Unlike desktop computing, in which if a hard disk crashes and destroy all your valuable data, a computer crashing in the cloud should not affect the storage of your data.
    - if your personal computer crashes, all your data is still out there in the cloud, still accessible
  - In a world where few individual desktop PC users back up their data on a regular basis, cloud computing is a data-safe computing platform!

Advantages of Cloud Computing

- Universal document access:
  - That is not a problem with cloud computing, because you do not take your documents with you.
  - Instead, they stay in the cloud, and you can access them whenever you have a computer and an Internet connection
  - Documents are instantly available from wherever you are
- Latest version availability:
  - When you edit a document at home, that edited version is what you see when you access the document at work.
  - The cloud always hosts the latest version of your documents
    - as long as you are connected, you are not in danger of having an outdated version

Advantages of Cloud Computing

- Easier group collaboration:
  - Sharing documents leads directly to better collaboration.
  - Many users do this as it is an important advantages of cloud computing
    - multiple users can collaborate easily on documents and projects
- Device independence.
  - You are no longer attached to a single computer or network.
  - Changes to computers, applications and documents follow you through the cloud.
  - Move to a portable device, and your applications and documents are still available.

Disadvantages of Cloud Computing

- Requires a constant Internet connection:
  - Cloud computing is impossible if you cannot connect to the Internet.
  - Since you use the Internet to connect to both your applications and documents, if you do not have an Internet connection you cannot access anything, even your own documents.
  - A dead Internet connection means no work and in areas where Internet connections are few or inherently unreliable, this could be a deal-breaker.

Disadvantages of Cloud Computing

- Does not work well with low-speed connections:
  - Similarly, a low-speed Internet connection, such as that found with dial-up services, makes cloud computing painful at best and often impossible.
  - Web-based applications require a lot of bandwidth to download, as do large documents.
- Features might be limited:
  - This situation is bound to change, but today many web-based applications simply are not as full-featured as their desktop-based applications.
    - For example, you can do a lot more with Microsoft PowerPoint than with Google Presentation's web-based offering

Disadvantages of Cloud Computing

- Can be slow:
    - Even with a fast connection, web-based applications can sometimes be slower than accessing a similar software program on your desktop PC.
    - Everything about the program, from the interface to the current document, has to be sent back and forth from your computer to the computers in the cloud.
    - If the cloud servers happen to be backed up at that moment, or if the Internet is having a slow day, you would not get the instantaneous access you might expect from desktop applications.

Disadvantages of Cloud Computing

- Stored data might not be secure:
  - With cloud computing, all your data is stored on the cloud.
    - The questions is How secure is the cloud?
  - Can unauthorised users gain access to your confidential data?

- Stored data can be lost:
  - Theoretically, data stored in the cloud is safe, replicated across multiple machines.
  - But on the off chance that your data goes missing, you have no physical or local backup.
    - Put simply, relying on the cloud puts you at risk if the cloud lets you down.

Probable Questions

- Compare and Contrast Grid Computing and Cloud Computing.
- Explain in brief the history of Cloud Computing.
- Discuss key characteristics of Cloud Computing.