Fundamental of Cloud Computing and Bigdata (TCS 351)

INSTRUCTOR:

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DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

GRAPHIC ERA (DEEMED TO BE) UNIVERSITY

Unit I

Introduction to Cloud Computing, Vision, History, Evolution, and Characteristics of Cloud Computing (NIST), Characteristic, Advantages and Disadvantages of Cloud Computing, Cloud computing vs. Cluster computing vs. Grid computing, Importance of Open Standards for digital age technologies.

Introduction to Cloud Computing

- Cloud computing is the delivery of computing services—including servers, storage, databases, networking, software, analytics, and intelligence—over the Internet ("the cloud") to offer faster innovation, flexible resources, and economies of scale. You typically pay only for cloud services you use, helping you lower your operating costs, run your infrastructure more efficiently, and scale as your business needs change.
- 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.

Vision

- Cloud computing provides the **facility to provision virtual hardware, runtime environment and services** to a person having money.
- The whole collection of computing system is transformed into collection of utilities, which can be provisioned and composed together to deploy systems in hours rather than days, with **no maintenance cost.**
- The long term vision of a cloud computing is that IT services are traded as utilities in an **open market without technological and legal barriers.**
- In the future, we can imagine that it will be possible to find the solution that matches with our requirements by simply **entering out request** in a global digital market that trades with cloud computing services.

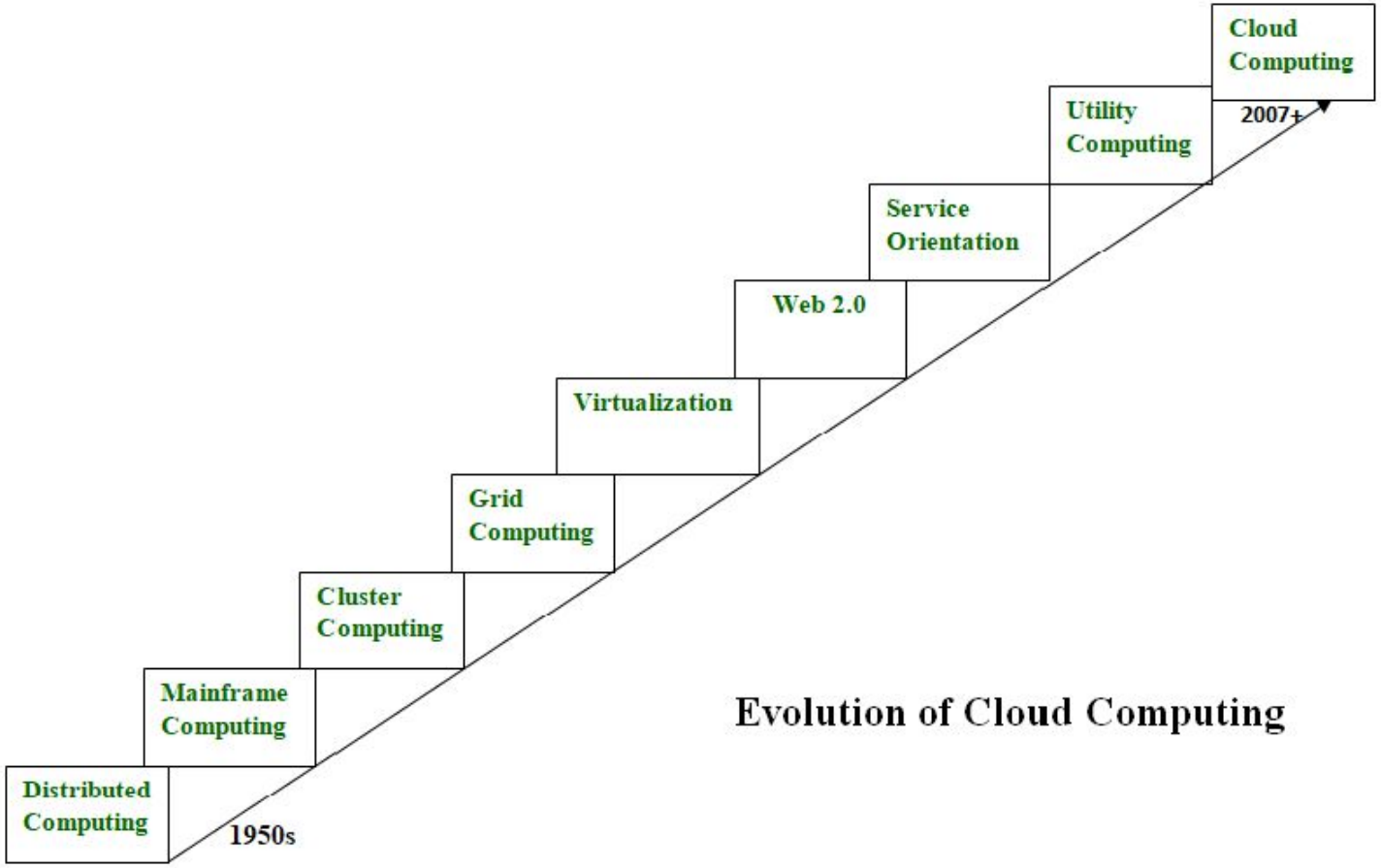
Vision (Contd.)

- The existence of such market will enable the **automation of discovery process** and its integration into its existing software systems.
- Due to the existence of a global platform for trading cloud services will also help service providers to **potentially increase their revenue**.
- A cloud provider can also become a **consumer of a competition service** in order to fulfill its promises to customers.
- In the near future we can imagine a solution that suits our needs **by simply applying our application to the global digital market** for cloud computing services.
- The presence of this market will enable the acquisition process to automatically **integrate with its integration into its existing software applications**. The availability of a global cloud trading platform will also help service providers to increase their revenue.
- A cloud provider can also be a **buyer of a competitive service** to fulfill its promises to customers.

History

- During 1961, John MacCharty delivered his speech at MIT that "**Computing Can be sold as a Utility, like Water and Electricity**." According to John MacCharty it was a brilliant idea. But people at that time don't want to adopt this technology. They thought the technology they are using efficient enough for them. So, this concept of computing was not appreciated much so and very less will research on it. But as the time fleet the technology caught the idea after few years this idea is implemented. So, this is implemented by Salesforce.com in 1999.
- This company started delivering an enterprise application over the internet and this way the boom of Cloud Computing was started.
- In 2002, Amazon started Amazon Web Services (**AWS),** Amazon will provide storage, computation over the internet. In 2006 Amazon will launch Elastic **Compute Cloud Commercial Service** which is open for Everybody to use.
- After that in 2009, Google Play also started providing Cloud Computing Enterprise Application as other companies will see the emergence of cloud Computing they also started providing their cloud services. Thus, in 2009, Microsoft launch Microsoft Azure and after that other companies like Alibaba, IBM, Oracle, HP also introduces their Cloud Services. In today the Cloud Computing become very popular and important skill.

Evolution



Evolution of Cloud Computing

Characteristics of Cloud Computing (NIST)

- **On-Demand Self-Service**: With cloud computing, you can provision computing services, like server time and network storage, automatically. You won't need to interact with the service provider. Cloud customers can access their cloud accounts through a web self-service portal to view their cloud services, monitor their usage, and provision and de-provision services.
- **Broad Network Access**: Another essential cloud computing characteristic is broad network access. You can access cloud services over the network and on portable devices like mobile phones, tablets, laptops, and desktop computers. A public cloud uses the internet; a private cloud uses a local area network. Latency and bandwidth both play a major role in cloud computing and broad network access, as they affect the quality of service.

Characteristics of Cloud Computing (NIST)

- **Resource Pooling:** With resource pooling, multiple customers can share physical resources using a multi-tenant model. This model assigns and reassigns physical and virtual resources based on demand. Multi-tenancy allows customers to share the same applications or infrastructure while maintaining privacy and security. Though customers won't know the exact location of their resources, they may be able to specify the location at a higher level of abstraction, such as a country, state, or data center. Memory, processing, and bandwidth are among the resources that customers can pool.

- **Rapid Elasticity:** Cloud services can be elastically provisioned and released, sometimes automatically, so customers can scale quickly based on demand. The capabilities available for provisioning are practically unlimited. Customers can engage with these capabilities at any time in any quantity. Customers can also scale cloud use, capacity, and cost without extra contracts or fees. With rapid elasticity, you won’t need to buy computer hardware. Instead, can use the cloud provider's cloud computing resources.

Characteristics of Cloud Computing (NIST)

- **Measured Service:** In cloud systems, a metering capability optimizes resource usage at a level of abstraction appropriate to the type of service. For example, you can use a measured service for storage, processing, bandwidth, and users. Payment is based on actual consumption by the customer via a pay-for-what-you-use model. Monitoring, controlling, and reporting resource use creates a transparent experience for both consumers and providers of the service.

Characteristics of Cloud Computing

- **Resiliency** : Resilience in cloud computing refers to the ability of a service to recover quickly from any disruption. Cloud resiliency is measured by how fast its servers, databases, and networks restart and recover after any damage. To prevent data loss, cloud services create a copy of the stored data. If one server loses data for any reason, the copy version from the other server restores.
- **Availability**: It is a related key concept in cloud computing. The benefit of cloud services is that you can access them remotely, so there are no geographic restrictions when using cloud resources.
- **Flexibility:** Companies need to scale as their business grows. The cloud provides customers with more freedom to scale as they please without restarting the server. They can also choose from several payment options to avoid overspending on resources they won't need.
- **Remote** Work: Cloud computing helps users work remotely. Remote workers can safely and quickly access corporate data via their devices, including laptops and smartphones. Employees who work remotely can also communicate with each other and perform their jobs effectively using the cloud.

Advantages of Cloud Computing

- **Cost:** Moving to the cloud helps companies optimize IT costs. This is because cloud computing eliminates the capital expense of buying hardware and software and setting up and running onsite datacenters—the racks of servers, the round-the-clock electricity for power and cooling, and the IT experts for managing the infrastructure. It adds up fast.
- **Speed:** Most cloud computing services are provided self service and on demand, so even vast amounts of computing resources can be provisioned in minutes, typically with just a few mouse clicks, giving businesses a lot of flexibility and taking the pressure off capacity planning.
- **Global scale:** The benefits of cloud computing services include the ability to scale elastically. In cloud speak, that means delivering the right amount of IT resources—for example, more or less computing power, storage, bandwidth—right when they're needed, and from the right geographic location.

Advantages of Cloud Computing (Contd.)

- **Productivity:** Onsite datacenters typically require a lot of "racking and stacking"—hardware setup, software patching, and other time-consuming IT management chores. Cloud computing removes the need for many of these tasks, so IT teams can spend time on achieving more important business goals.
- **Performance:** The biggest cloud computing services run on a worldwide network of secure datacenters, which are regularly upgraded to the latest generation of fast and efficient computing hardware. This offers several benefits over a single corporate datacenter, including reduced network latency for applications and greater economies of scale.

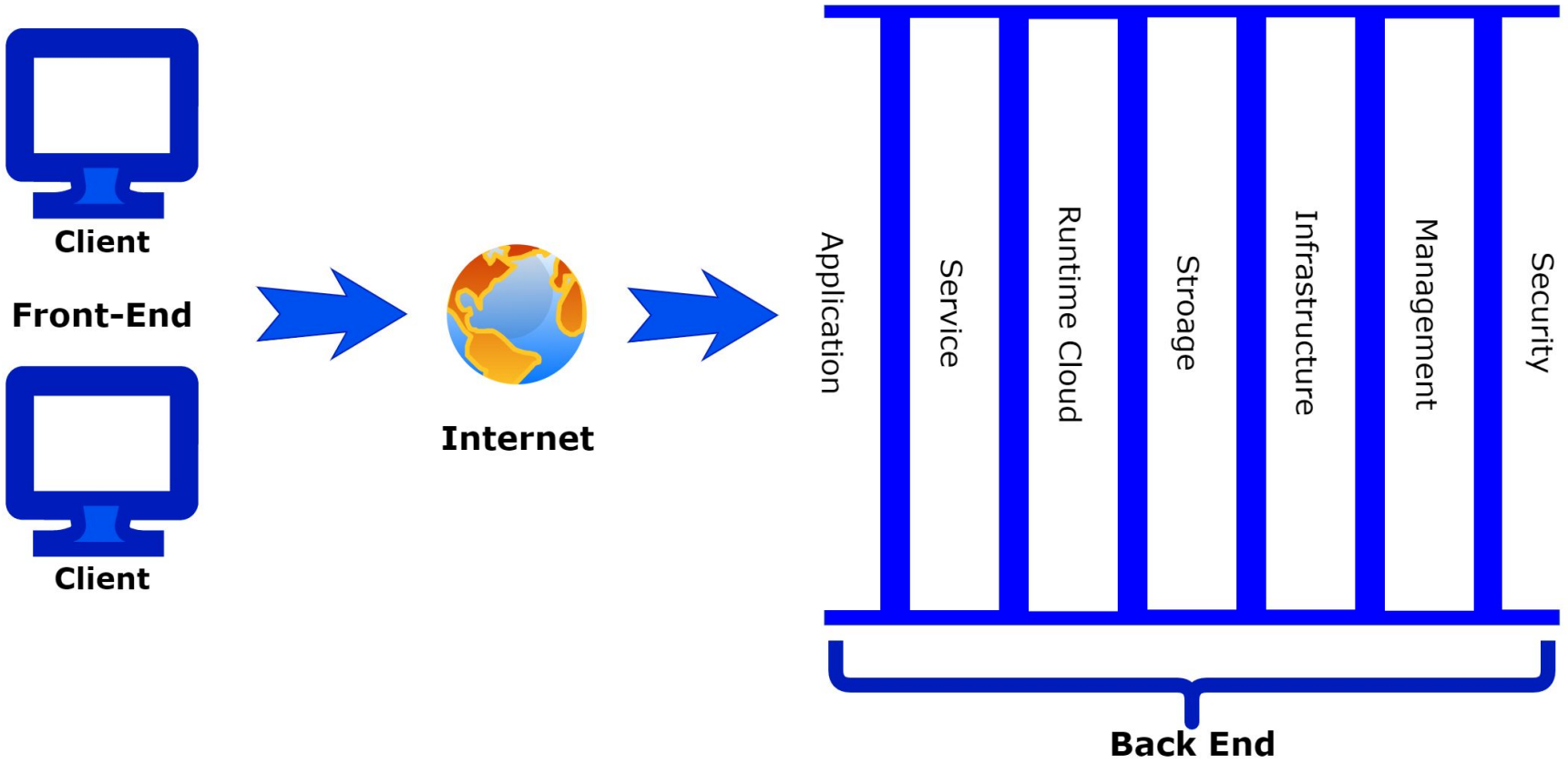
Advantages of Cloud Computing (Contd.)

- **Reliability:** Cloud computing makes data backup, disaster recovery, and business continuity easier and less expensive because data can be mirrored at multiple redundant sites on the cloud provider's network.
- **Security:** Many cloud providers offer a broad set of policies, technologies, and controls that strengthen your security posture overall, helping protect your data, apps, and infrastructure from potential threats.

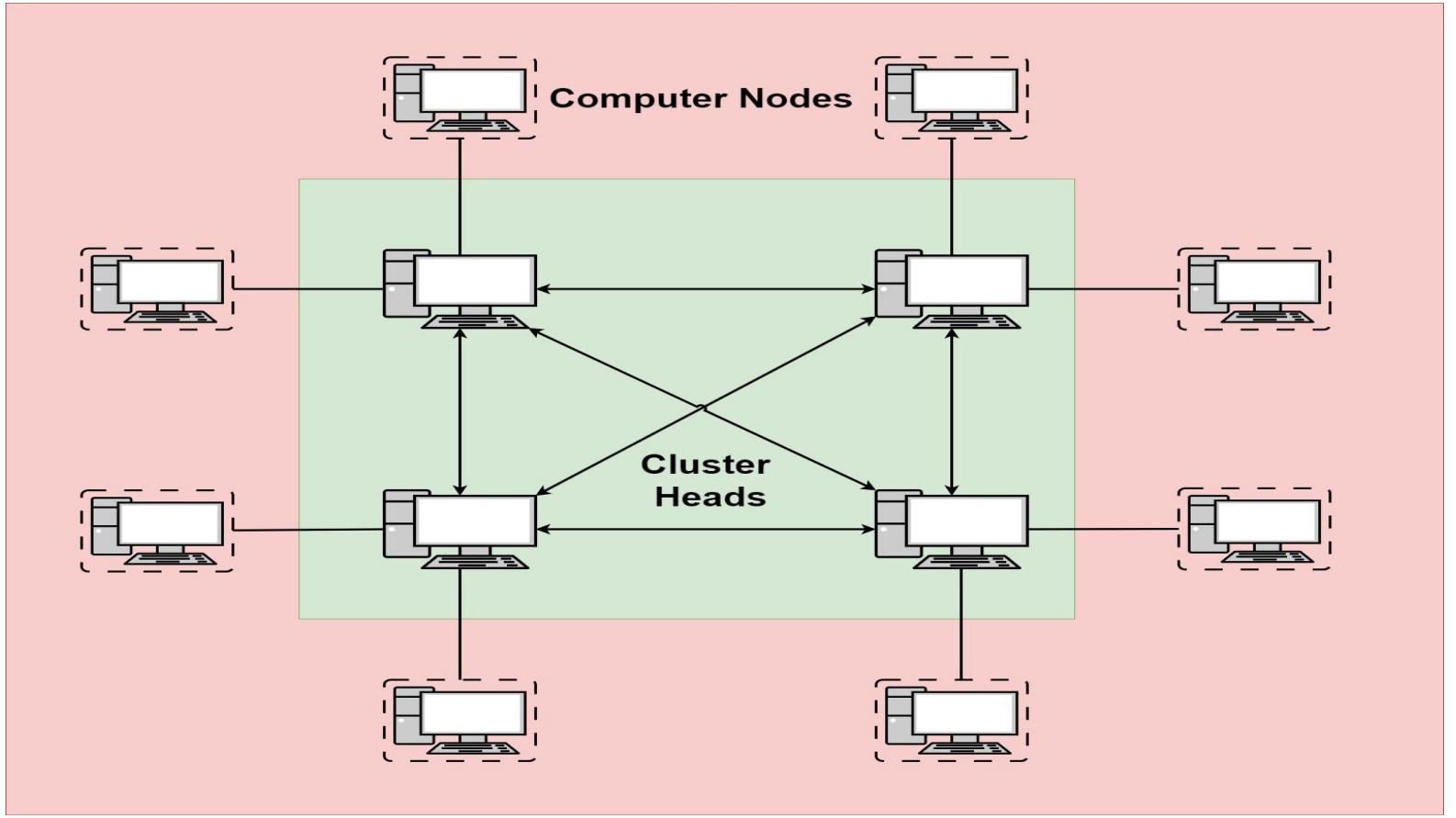
Disadvantages of Cloud Computing

- Data loss or theft.
- Data leakage.
- Account or service hijacking.
- Insecure interfaces and API's.
- Denial of service attacks.
- Technology vulnerabilities, especially in shared environments.

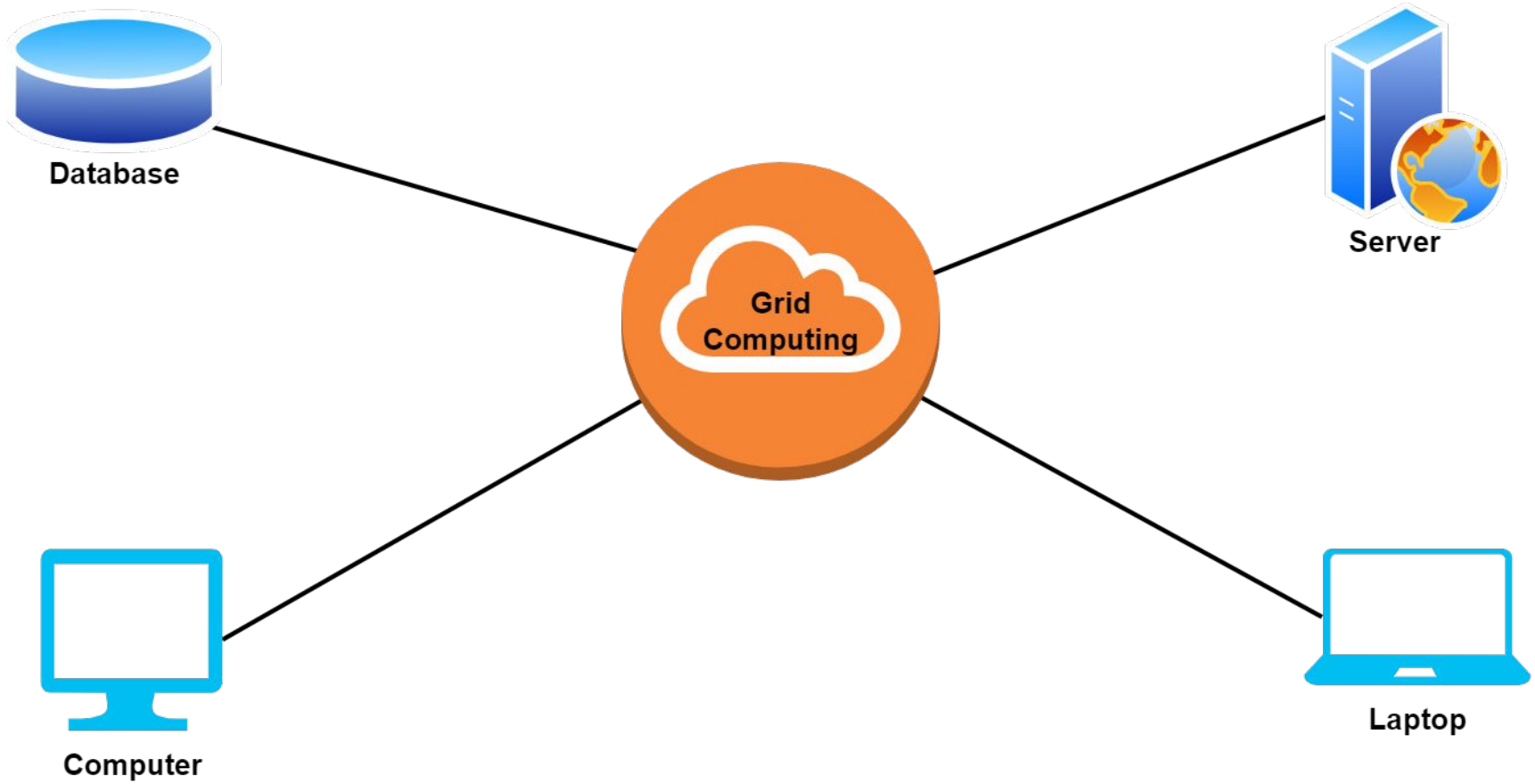
Cloud computing architecture



Cluster computing architecture



Grid computing architecture



Cloud computing vs. Cluster computing vs. Grid computing

Cloud	Grid	Cluster
Consolidation of resources	Segregation of resources	Aggregation of resources
Single system made up of many systems	Collection of systems that act together like a single system	Group of nodes that are connected to each other
Works with different hardware and OS	Works with different hardware and OS	All the connected systems should have same OS and hardware
Follows centralized architecture	Follows distributed architecture	Follows centralized architecture
Suffers from a single point of failure	All the nodes work independently, hence no single point of failure	Suffers from a single point of failure
The owners have less control over the systems on the cloud	The owners have full control and management over the grid's systems	Have no owners, and each node works independently
Job execution is self-managed	Scalability of execution allows for the transfer of a job's execution to an available processor	The scheduling of jobs affects execution. Jobs, therefore, wait until their designated runtime
Used in Dropbox, Gmail	Used in simulations, automations	Used in web servers, search engines

Importance of Open Standards for digital age technologies

The International Telecommunication Union Telecommunication Standardization Sector (ITU-T) has a long history of open standards development. However, recently some different external sources have attempted to define the term "Open Standard" in a variety of different ways. In order to avoid confusion, the ITU-T uses for its purpose the term "Open Standards" per the following definition:

"Open Standards" are standards made available to the general public and are developed (or approved) and maintained via a collaborative and consensus driven process. "Open Standards" facilitate interoperability and data exchange among different products or services and are intended for widespread adoption.

Importance of Open Standards for digital age technologies (Contd.)

Other elements of "Open Standards" include, but are not limited to:

- Collaborative process- voluntary and market driven development (or approval) following a transparent consensus driven process that is reasonably open to all interested parties.
- Reasonably balanced- ensures that the process is not dominated by any one interest group.
- Due process - includes consideration of and response to comments by interested parties.

Importance of Open Standards for digital age technologies (Contd.)

- Intellectual property rights (IPRs)- IPRs essential to implement the standard to be licensed to all applicants on a worldwide, non-discriminatory basis, either (1) for free and under other reasonable terms and conditions or (2) on reasonable terms and conditions (which may include monetary compensation). Negotiations are left to the parties concerned and are performed outside the formal standards-developing organizations (SDO).
- Quality and level of detail- sufficient to permit the development of a variety of competing implementations of interoperable products or services. Standardized interfaces are not hidden, or controlled other than by the SDO promulgating the standard.
- Publicly available- easily available for implementation and use, at a reasonable price. Publication of the text of a standard by others is permitted only with the prior approval of the SDO.
- On-going support- maintained and supported over a long period of time.

Importance of Open Standards for digital age technologies (Contd.)

- Open standards enable interoperability and data exchange among different products or services so technologies can be widely adopted.
- In addition to providing product frameworks, digital standards help ensure transparent and safe applications of technologies and enable coordinated interoperability across manufacturers.

Assignment 1 (CO1)

Q. 1 Briefly explain the Characteristics of Cloud Computing as per NIST.

Q. 2 Briefly explain Advantages and Disadvantages of Cloud Computing.

Q. 3 Briefly explain the difference between Cloud computing vs. Cluster computing vs. Grid computing.

Q. 4 Briefly explain the importance of Open Standards.

Submission link for GEHU: https://forms.gle/DjMizc6cCN81ruy8A

Submission deadline: 10/09/2023

Class presentation (Choose any one topic)

- Basics of Cloud Computing,
- Characteristics of Cloud Computing (NIST),
- Advantages and Disadvantages of Cloud Computing,
- Cloud computing vs. Cluster computing vs. Grid computing,
- Importance of Open Standards for digital age technologies

Submission link for GEHU: https://forms.gle/sMQSDFVVZM76cePB8

Submission deadline: 10/09/2023

(Duration: 6-8 Minutes, No. of slides: 6-10)

The recorded presentation will be uploaded using submission link.