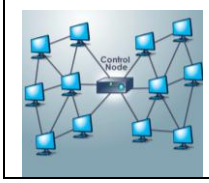
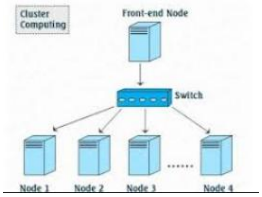
Cloud Computing

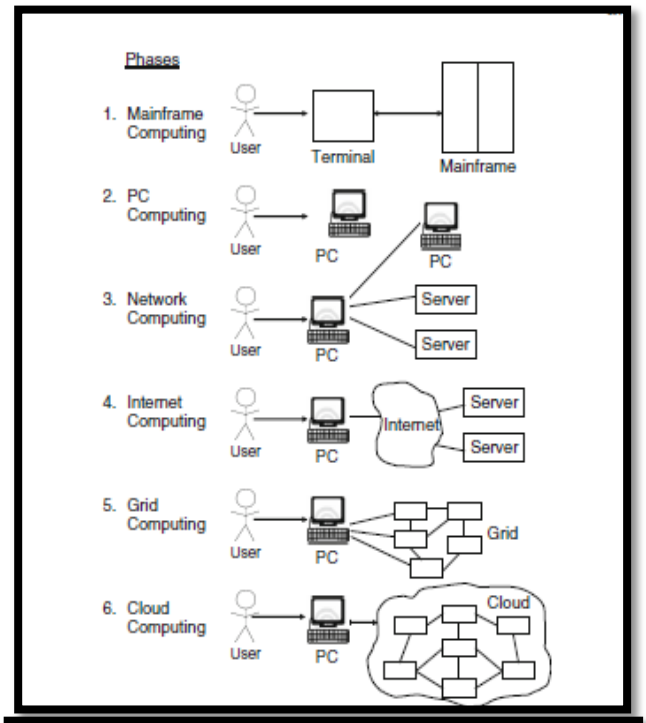
Que 1 : Difference between grid, cluster and cloud computing.

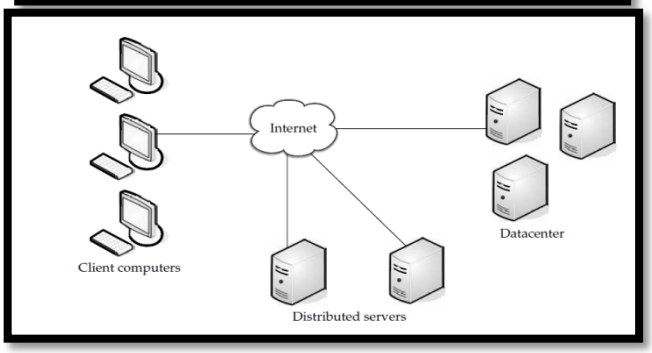
Grid Computing	Cloud Computing
A Grid is basically the one that uses the processing capabilities of different computing units for processing a single task. The task is broken into multiple sub-tasks, each machine on a grid is assigned a task. As when the sub-tasks are completed they are sent back to the primary machine which takes care of the all the tasks. They are combined or clubbed together as an output.	Cloud computing is a computing paradigm, where a large pool of systems are connected in private or public networks, to provide dynamically scalable infrastructure for application, data and file storage.
Grid doesn't offer multitude of services.	Cloud offers more services than grid computing. In fact almost all the services on the Internet can be obtained from cloud, eg web hosting, multiple Operating systems, DB support and much more.
Grid computing is a decentralized model where the computation could occur over many administrative domains.	Cloud computing is a centralized model.
A grid is a collection of computers which is owned by multiple parties in multiple locations and connected together so that users can share the combined power of resources.	Whereas a cloud is a collection of computers usually owned by a single party.
Example : FutureGrid  	Example : Amazon Web Services (AWS), Google App Engine 

Cluster Computing : A cluster is different from those two. Clusters are two or more computers who share a network connection that acts as a heart-beat. Clusters are configurable in Active-Active or Active-Passive ways.

	Cluster	Grid	Cloud
Resource Handling	Centralized	Distributed	Both
Loose coupling / Scalable	No	Both	Yes
Reliability/ User friendliness	No	Half	Full
Network type	Private	Private	Public Internet
Virtualization	Half	Half	Yes
Business Model	No	No	Yes
Task Size	Single large	Single large	Small, medium & large
Heterogeneity	No	Yes	Yes
Security	High	Medium / High	Low / Medium
Value Added Service	No	Both	Yes
Cost	Very High	High	Low

Que 2 : Basic Concepts of Cloud Computing.





Cloud Computing

Forrester defines cloud computing as: "A pool of abstracted, highly scalable, and managed compute infrastructure capable of hosting end-customer applications and billed by consumption."

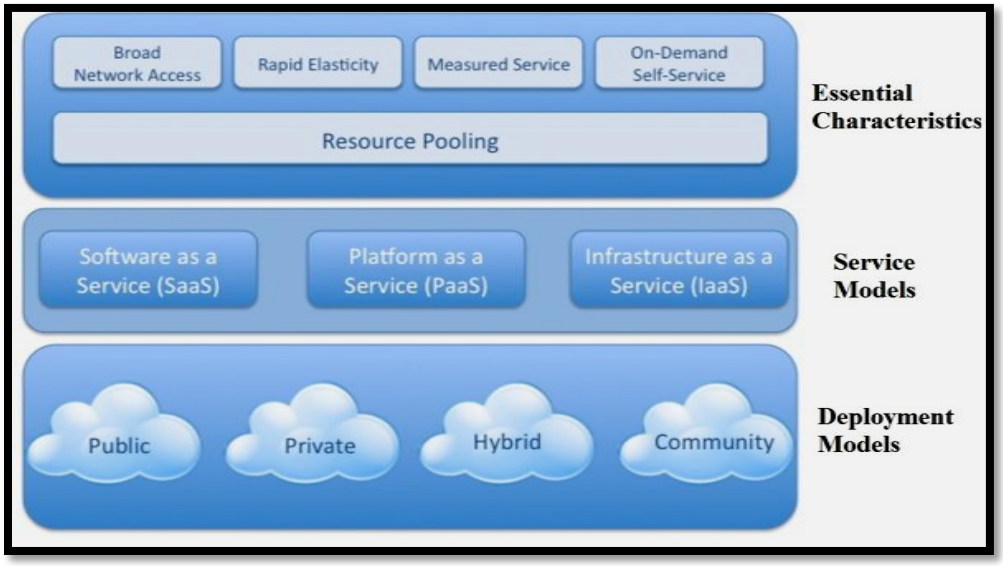
Objectives of Cloud Computing

- **Elasticity:** Ability to scale virtual machines resources up or down
- **On-demand usage:** Ability to add or delete computing power (CPU, memory), and storage according to demand
- **Pay-per-use:** Pay only for what you use
- **Multitenancy:** Ability to have multiple customers access their servers in the data center in an isolated manner

Components of Cloud

- Clients
- Datacenter
- Distributed Servers
- Infrastructure

Architecture of Cloud Computing :



(1) Deployment Models (2) Service Models (3) Essential Characteristics

(1) Deployment Models :

Public cloud: Public cloud or external cloud describes cloud computing in the traditional mainstream sense, whereby resources are dynamically provisioned on a fine-grained, selfservice basis over the Internet, via web applications/web services from an off-site third-party provider who bills on a fine-grained utility computing basis. The cloud infrastructure is made available to the general public or a large industry group, and is owned by an organization selling cloud services. Examples: Amazon Elastic-Compute-Cloud, IBM's BlueCloud, Sun Cloud, Google AppEngine.

- Avaiability
- Scalability
- Accessibility
- Cost saving

Community cloud: A community cloud may be established where several organizations have similar requirements and seek to share infrastructure so as to realize some of the benefits of cloud computing. With the costs spread over fewer users than a public cloud (but more than a single tenant) this option is more expensive but may offer a higher level of privacy, security and/or policy compliance. Examples of community cloud include Google's "Gov Cloud"

- Cost
- Multitenancy

Hybrid cloud: The term "Hybrid Cloud" has been used to mean either two separate clouds joined together (public, private, internal or external), or a combination of virtualized cloud server instances used together with real physical hardware. The most correct definition of the term "Hybrid Cloud" is probably the use of physical hardware and virtualized cloud server instances together to provide a single common service. Two clouds that have been joined together are more correctly called a "combined cloud". A hybrid storage cloud uses a combination of public and private storage clouds. Hybrid storage clouds are often useful for archiving and backup functions, allowing local data to be replicated to a public cloud.

Private cloud: A private cloud is a particular model of cloud computing that involves a distinct and secure cloud based environment in which only the specified client can operate. As with other cloud models, private clouds will provide computing power as a service within a virtualized environment using an underlying pool of physical computing resource. However, under the private cloud model, the cloud (the pool of resource) is only accessible by a single organization providing that organization with greater control and privacy.

- Support and troubleshooting
- Maintenance
- Monitoring

(2) Characteristics of Cloud Computing

1. **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.
2. **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).
3. **Resource pooling:** The provider's computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. There is a sense of location independence in that the customer generally has no control or knowledge over the exact location of the provided resources but may be

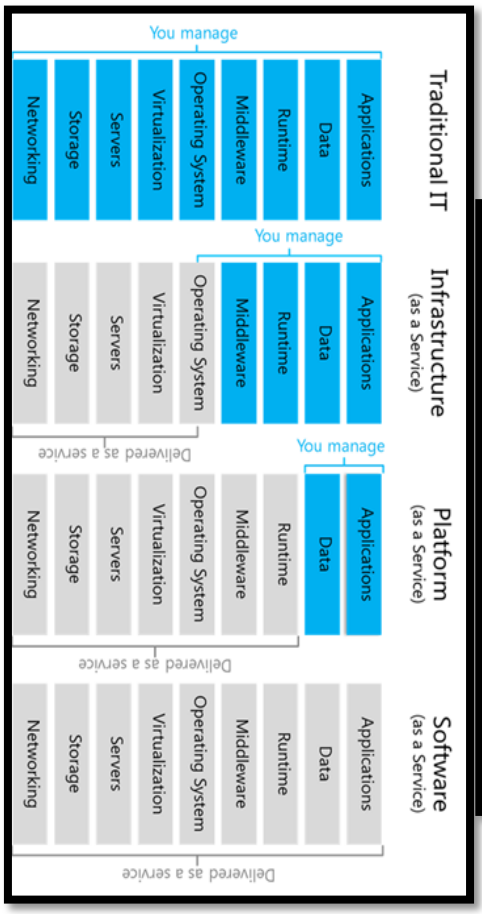
able to specify location at a higher level of abstraction (e.g., country, state or datacenter). Examples of resources include storage, processing, memory and network bandwidth.

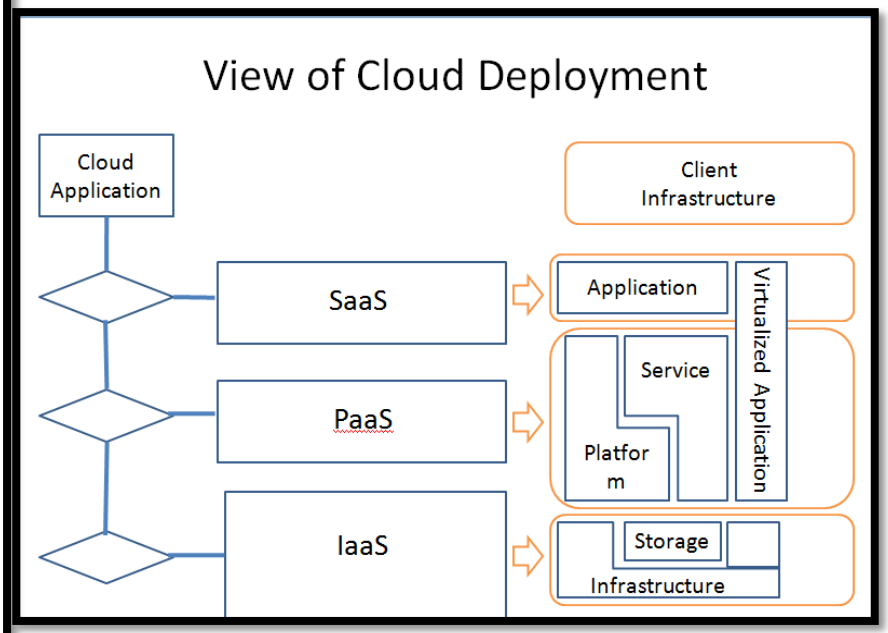
4. **Rapid elasticity:** Capabilities can be elastically provisioned and released, in some cases automatically, to scale rapidly outward and inward commensurate with demand. To the consumer, the capabilities available for provisioning often appear to be unlimited and can be appropriated in any quantity at any time.

5. **Measured service:** Cloud systems automatically control and optimize resource use by leveraging a metering capability at some level of abstraction appropriate to the type of service (e.g., storage, processing, bandwidth and active user accounts). Resource usage can be monitored, controlled and reported, providing transparency for the provider and consumer.

(2) Service Models

- **Cloud Software as a Service (SaaS)**
  - Use provider's applications over a network
  - User doesn't manage or control the network, servers, OS, storage or applications
- **Cloud Platform as a Service (PaaS)**
  - Users deploy their applications on a cloud
  - Users control their apps
  - Users don't manage servers, IS, storage
- **Cloud Infrastructure as a Service (IaaS)**
  - Rent processing, storage, network capacity, and other fundamental computing resources
  - Consumers gets access to the infrastructure to deploy their stuff
  - Don't manage or control the infrastructure
  - Do manage or control the OS, storage, apps, selected network components





Que 3: Issues with Cloud Computing

1. Security and privacy
2. Performance
3. Selecting the perfect cloud set-up
4. Real time monitoring requirements
5. Reliability and availability
6. Scalability and elasticity
7. Interoperability and portability
8. Resource management and scheduling
9. Energy consumption
10. Virtualization
11. Bandwidth costs
12. Lack of knowledge and expertise
13. Recovery of lost data
14. Cost management
15. QoS
16. Big data

Table 6: Top 10 Obstacles to and Opportunities for Adoption and Growth of Cloud Computing.

	Obstacle	Opportunity
1	Availability of Service	Use Multiple Cloud Providers to provide Business Continuity; Use Elasticity to Defend Against DDOS attacks
2	Data Lock-In	Standardize APIs; Make compatible software available to enable Surge Computing
3	Data Confidentiality and Auditability	Deploy Encryption, VLANs, and Firewalls; Accommodate National Laws via Geographical Data Storage
4	Data Transfer Bottlenecks	FedExing Disks; Data Backup/Archival; Lower WAN Router Costs; Higher Bandwidth LAN Switches
5	Performance Unpredictability	Improved Virtual Machine Support; Flash Memory; Gang Scheduling VMs for HPC apps
6	Scalable Storage	Invent Scalable Store
7	Bugs in Large-Scale Distributed Systems	Invent Debugger that relies on Distributed VMs
8	Scaling Quickly	Invent Auto-Scaler that relies on Machine Learning; Snapshots to encourage Cloud Computing Conservationism
9	Reputation Fate Sharing	Offer reputation-guarding services like those for email
10	Software Licensing	Pay-for-use licenses; Bulk use sales