Cloud Computing

Week 2 - Topics covered:

- What is cloud computing?
- Historical developments
- Brief overview of cluster and grid computing
- Difference between cluster, grid and cloud computing

Cloud Computing

What is Cloud Computing?

Introduction to Cloud Computing

- Definition by National Institute of Science and Technology (NIST) USA:

  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.

Introduction to Cloud Computing

- Essential Characteristics according to NIST definition:
  - On-demand self-service
  - Broad network access
  - Resource pooling
  - Rapid elasticity
  - Measured service

Introduction to Cloud Computing

- 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.

Introduction to Cloud Computing

- Resource pooling: The provider's computing resources are pooled to serve multiple consumers according to consumer demand. The customer generally has no control or knowledge over the exact location of the provided resources (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

Introduction to Cloud Computing

- Resource pooling: The provider's computing resources are pooled to serve multiple consumers according to consumer demand. The customer generally has no control or knowledge over the exact location of the provided resources (e.g., country, state, or datacenter). Examples of resources include storage, processing, memory, and network bandwidth.

Introduction to Cloud Computing

- Measured service: Cloud systems automatically control and optimize resource use by leveraging a metering capability. Typically this is done on a pay-per-use or charge-per-use basis.

Cloud Computing

Historical Developments

Brief History of Cloud Computing

- Computer Scientist John McCarthy is attributed with delivering the idea that computations will be provisioned as utilities in future. This idea was presented in 1961.

Brief History of Cloud Computing

- In 1960s and 1970s, the mainframes (giant powerful computers) were leased out by the manufacturers.
- The idea of grid computing emerged in 1990s to use the processing power of networked PCs for scientific calculations during idle times.

Brief History of Cloud Computing

- In 1990s, Salesforce.com started bringing remotely provisioned software services to the enterprises. Amazon Web Services (AWS) were launched in 2002.

Brief History of Cloud Computing

- In 2006, the term “cloud computing” emerged that enabled organizations to “lease” the computing capacity and processing power from cloud providers.

Cloud Computing

Cluster Computing

Overview of Cluster Computing

- A computer cluster is a collection of interconnected stand-alone computers which cooperate together to work as a single resource pool of computing resources.
- Clusters became popular in 1990s when mainframes and traditional supercomputers were becoming less cost-effective for high performance computing (HPC).

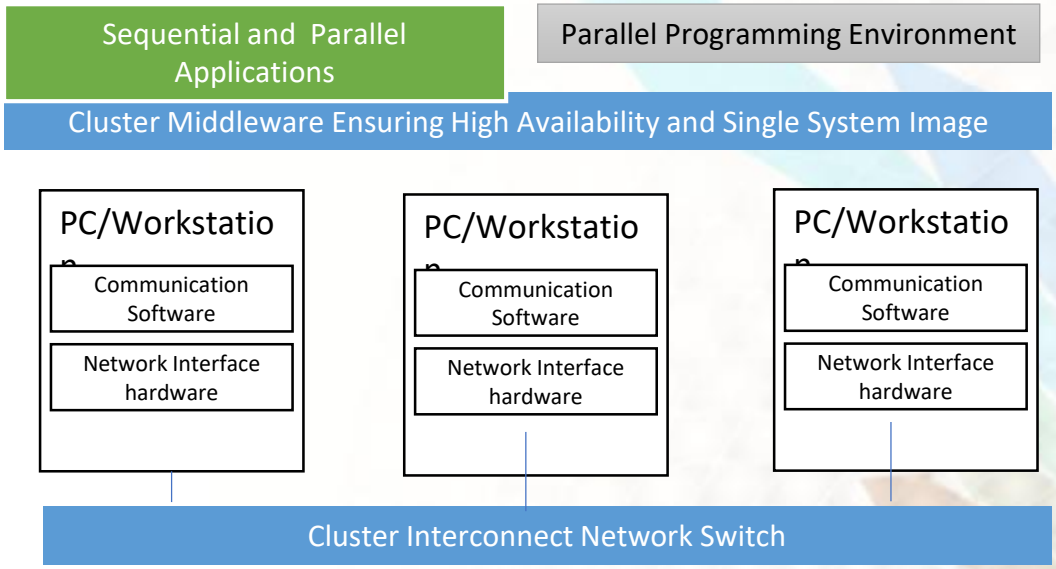
Overview of Cluster Computing

- In 2010, out of top 500 supercomputers. 85% were computer clusters built with homogeneous nodes.
- Cluster computing has laid the foundation of modern day super computers, computational grids and cloud computing.

Overview of Cluster Computing

- Important Benefits of Cluster Computing:
  - Scalability
  - High availability and fault tolerance
  - Use of commodity computers

Overview of Cluster Computing



Cloud Computing

Grid Computing

Overview of Grid Computing

- The grid is an integrated computing infrastructure for bringing together computers to create a large collection of compute, storage, and network resources.

Overview of Grid Computing

- Grid is used to solve large-scale computation problems or to enable fast information retrieval by registered users or user groups.
- Computers include PCs, workstations, server clusters, supercomputers, laptops, notebooks, mobile computers, PDAs, etc.

Overview of Grid Computing

- Building virtual grid through CPU scavenging: Creating a grid by using unutilized CPU cycles in a network of computers at night or periods of inactivity.
- This is done on voluntary basis. The grid hosts donate some RAM, disk space and network bandwidth as well.
- The most famous example is the SETI@Home which applied over 3 million computers to achieve 23.37 TFlpos as of Sept. 2001.

Overview of Grid Computing

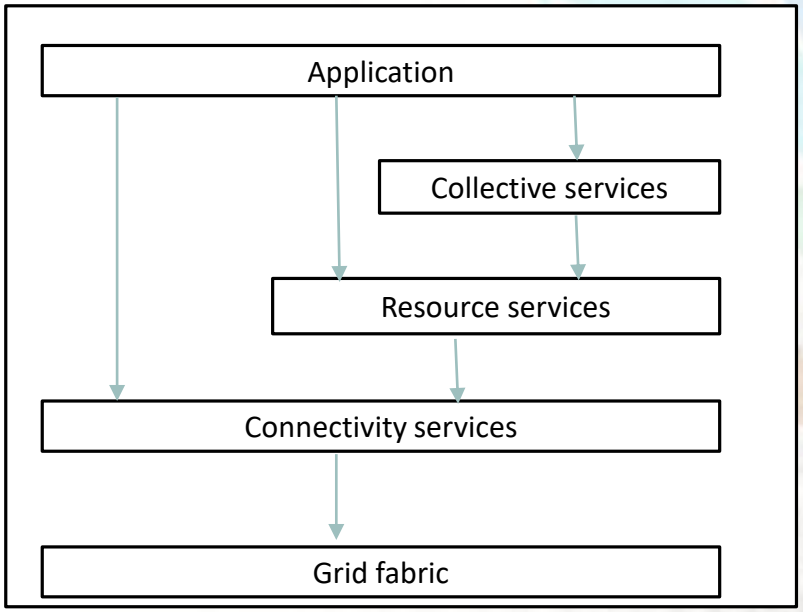
- Application: The top layer consisting of user applications to be run on grid.
- Collective Services: Focus on interaction among the resources. implements functions such as resource discovery, scheduling, brokering etc.

Overview of Grid Computing

- Resource service: Deals with the aggregated computing resources (software and hardware) available for user applications in collective operations.
- Connectivity Layer: Provides the core networking among the computational resources of fabric layer through physical or virtual networking.
- Grid fabric: Consists of all the computational resources such as storage systems, catalogs, network resources, servers and their network connections.

Overview of Grid Computing

- Grid Middle ware Layered Architecture (deployed on participant computers)



Cloud Computing

Difference between Cluster, Grid and Cloud Computing

Difference between Cluster, Grid and Cloud Computing

- The purpose of Grid Computing is to solve large scale computational problems.
  - Just like Clusters, except that
  - The Grids make use of computational resources are spread across the nation or the globe.
  - These computational resources are owned by different organizations and are shared (as grid resources) by multiple users.

Difference between Cluster, Grid and Cloud Computing

- Grids heavily depend upon WAN/LAN resources.
- Virtual Supercomputer term is derived from Grid Computing whereby multiple computers collaborate together over network to create an illusion of a single big computer.

Difference between Cluster, Grid and Cloud Computing

- Grids heavily depend upon WAN/LAN resources.
- Virtual Supercomputer term is derived from Grid Computing whereby multiple computers collaborate together over network to create an illusion of a single big computer.

Difference between Cluster, Grid and Cloud Computing

- Grid Computing:
  - As compared to cloud:
  - The resources do not join or leave the grid dynamically.
  - Majority of the resources are not provisioned from data centers.
  - Several organizations may unite to form a grid in the shape of a virtual organization (VO). For example multiple hospitals and research centers may collaborate in a VO to find a cure for cancer.