22AIE305

22AIE305: CLOUD COMPUTING

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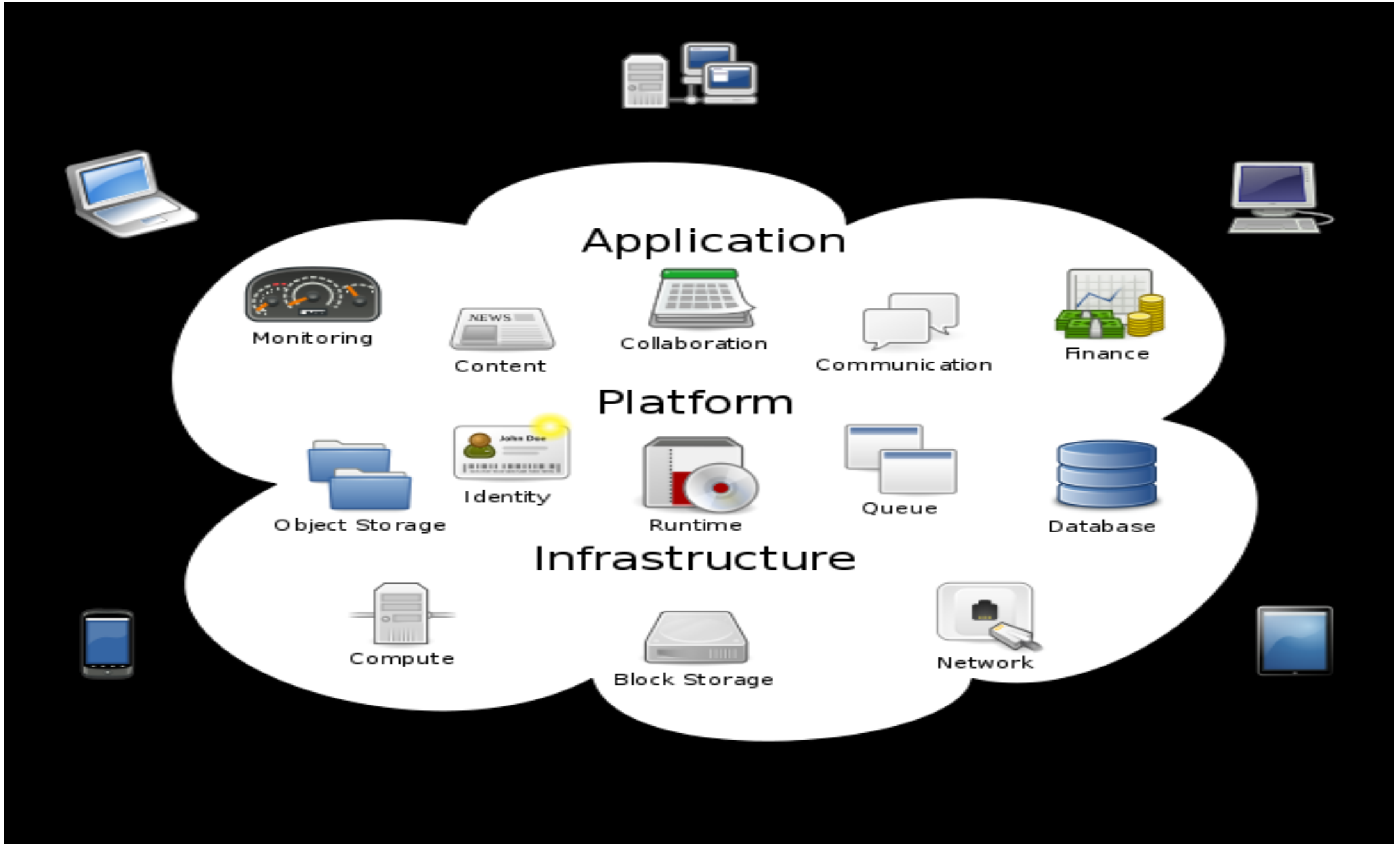

Application
Monitoring
NEWS
Content
Collaboration
Communication
Finance
Platform
Object Storage
Identity
Runtime
Queue
Database
Infrastructure
Compute
Block Storage
Network

Motivation

- Inherently distributed applications
- Performance/cost
- Resource sharing
- Flexibility and extensibility
- Availability and fault tolerance
- Scalability

- High-speed network connectivity is ever increasing.
- Combination of cheap processors are often more cost-effective than one expensive fast system (such as supercomputer).
- Potential increase of reliability.

Cluster computing

1. What is cluster computing?
2. Need of cluster computing.
3. Architecture
4. Applications of cluster computing
5. Advantages of cluster computing
6. Disadvantages of cluster computing

What is cluster computing?

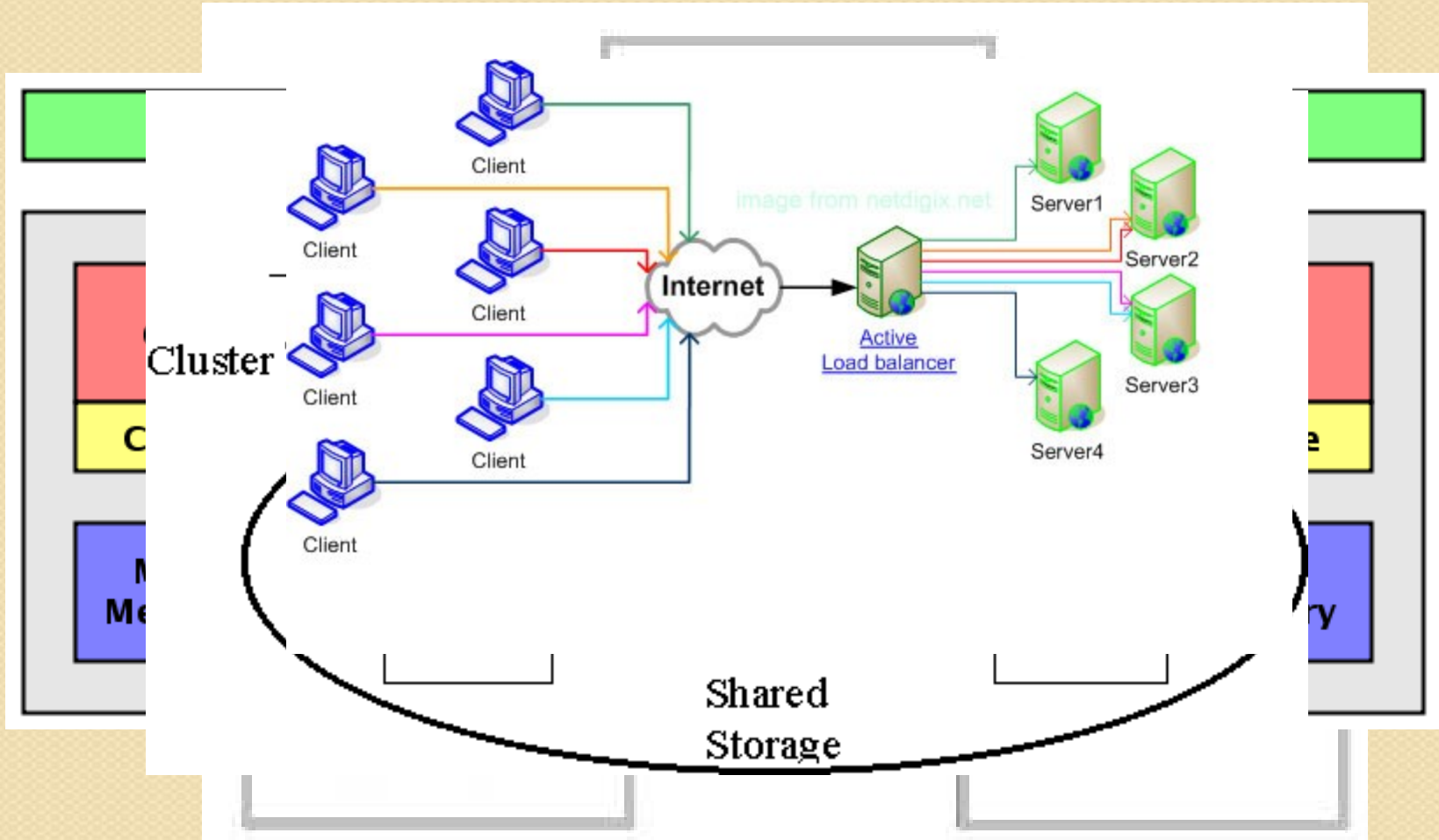
Definition:-

A cluster is a type of parallel or distributed processing system, which consists of a collection of interconnected stand-alone computers cooperatively working together as a single integrated computing resource.

Need for cluster computing

- To increase efficiency
- To reduce the execution time
- To cut-down expenses
- To achieve high reliability

Architecture



Cluster Computing

A Network of Independent standalone computers that works as a single integrated computing platform.

Each computer that is connected to the network is called a node.

Nodes may be of the same type running the same software (but OS can differ)

Example software to build clusters are PVM, WinPVM, MPI, OpenMP which are all available in various OS

Cluster Computing Features

Cluster computing offers solutions to solve complicated problems by providing faster computational speed, and enhanced data integrity

Features of Cluster computing

- All the connected computers are the same kind of machines
- They are tightly connected through dedicated network connections
- All the computers share a common home directory.

Types of Cluster Computing

- High-availability clusters: They are meant to support server applications and are maintained with a minimum down-time. Redundant computers are harnessed in a cluster to maintain high level of reliability and to maintain the down time.
- High performance computing clusters: This networking approach utilizes supercomputers to resolve complex computational problems. The jobs are submitted to clusters for execution and cluster will manage the resources required for the job.

Advantages of Cluster Computing

- **Cost efficacy**
- **Processing speed**
- **Extended resource availability**: When one node gets failed, the other nodes will be active and will function as a proxy for the failed node. This makes sure for enhanced availability.
- **Expandability**
- **Flexibility**: Cluster computing can be upgraded to the superior specification or extended through the addition of additional nodes (computer systems).

The cluster consists of four major parts. These parts are:

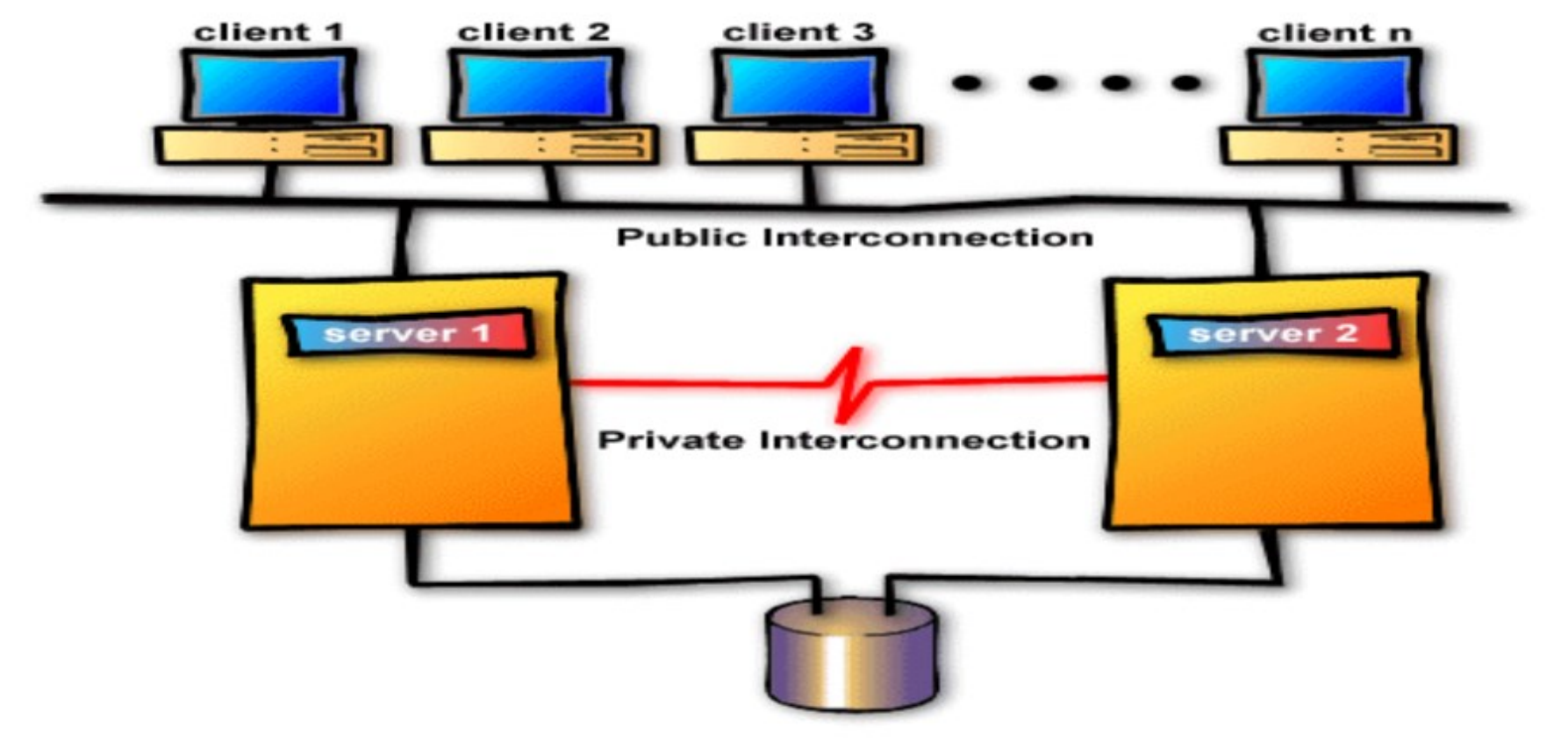
1) Network,
2) Compute nodes,
3) Master server,
4) Gateway.

High Availability Clusters

HA Clusters are designed:

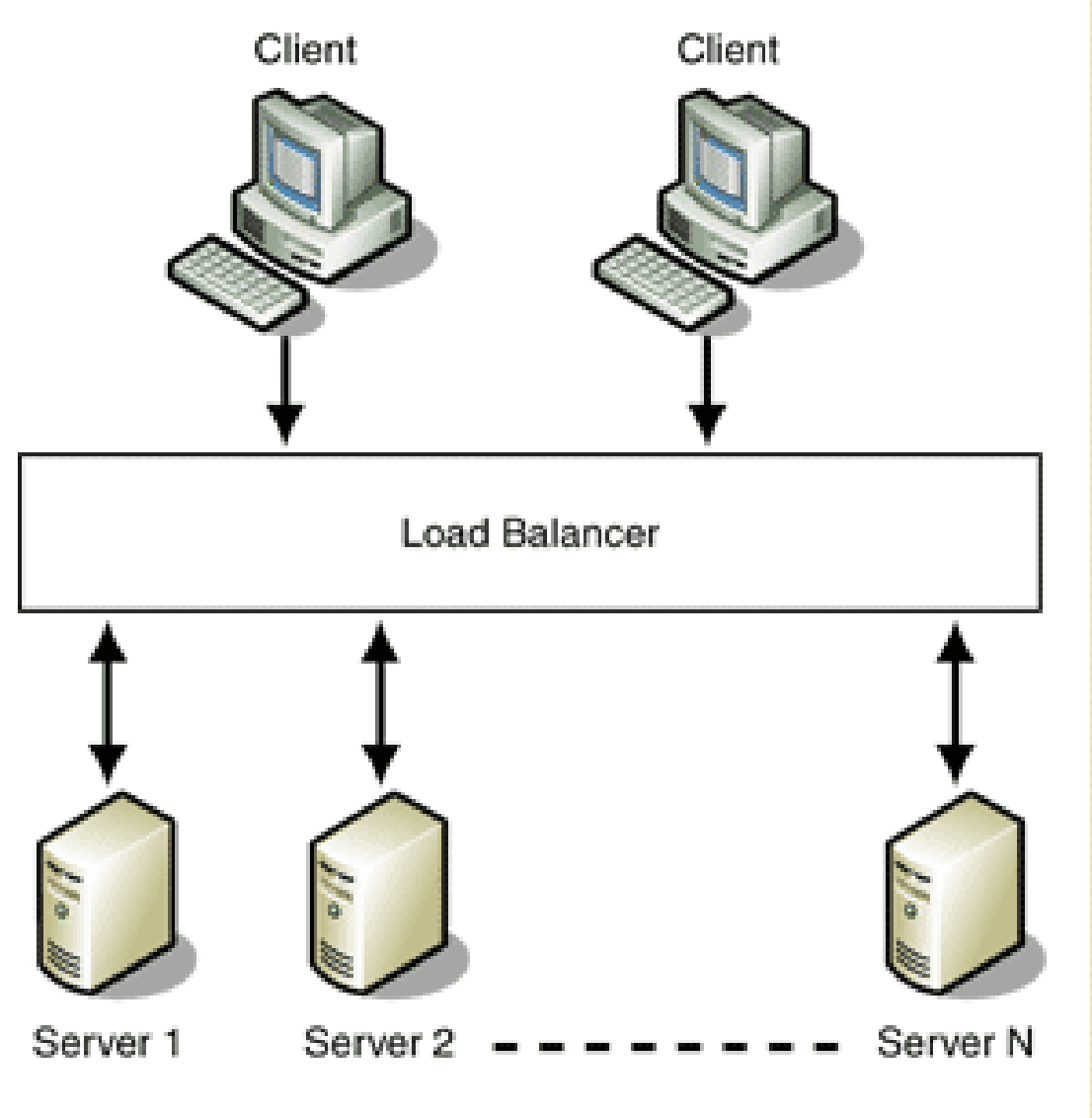
- to ensure constant access to service applications.
- to maintain redundant nodes

High Availability Clusters



Load-balancing Clusters

“load balancing” clusters are configurations in which cluster -nodes share computational workload to provide better overall performance”.


Client
Client
Load Balancer
Server 1
Server 2
Server N

High-performance Clusters

• are designed to exploit the parallel processing power of multiple nodes.

Networked Cluster Computing

- Networked Computers as a Computing Platform.
  - These became an attractive alternative to expensive supercomputers in the early 1990’s
  - There were several early projects.
    - Berkeley NOW Project (network of workstations)
    - NASA Beowulf project.

Key Advantages

- Very High performance workstations and PC’s readily available at low cost.
- The latest processors can easily be incorporated into the system as they become available.
- Existing software can be used or modified.

Cluster Configurations

- Existing Networked Computers
  - Like the ECC lab.
  - You need to be kind to the interactive users (those at the console)
  - Problem – they can shut off one machine and mess up your computation.

Cluster Configurations

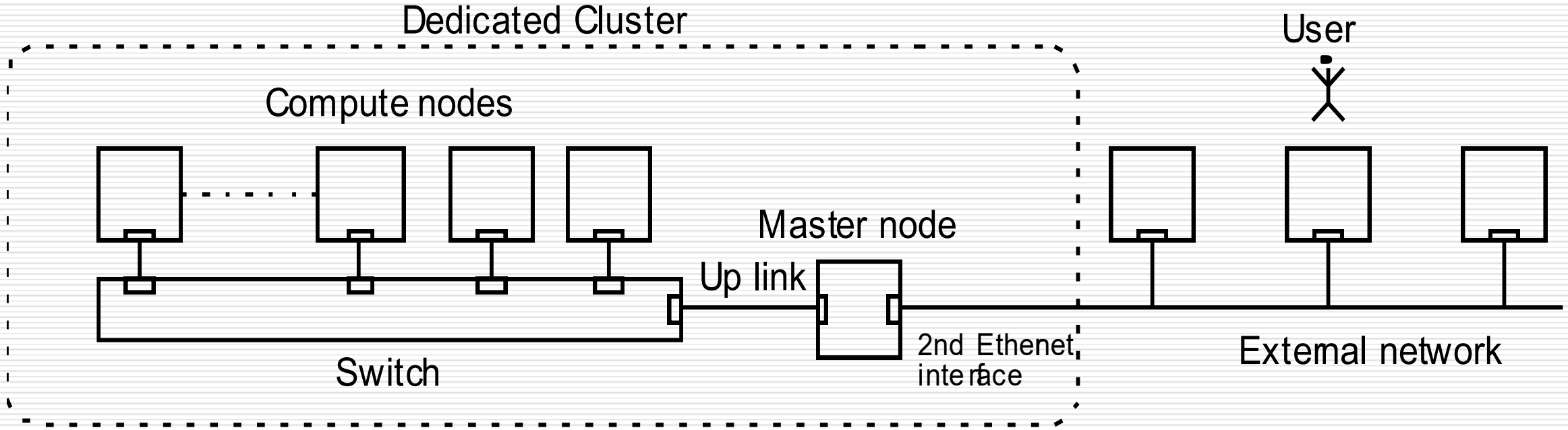
- Beowulf Clusters
  - A group of interconnected “commodity” computers achieving high performance with low cost.
  - Typically using commodity interconnects (high speed Ethernet), and Linux OS
  - The Beowulf project started at NASA Goddard in 1993

Cluster Configurations

- Beyond Beowulf
  - Cluster Interconnects
    - Originally Fast Ethernet
    - Now Gigabit Ethernet
  - More Specialized Interconnects
    - Myrinet – 2.4Gbits/sed
    - cLan
    - SCI
    - QNet
    - Infiniband

Setting up a Cluster

- Hardware Configuration



Setting up a Cluster

- Software Tools (Middleware)
  - PVM –
    - Developed in the late 1980’s
  - MPI
    - Standard defined in the late 1990’s
- OpenMP

Applications of cluster computing

- Scientific computing
- Data mining
- Comercial server

5.Advantages of cluster computing

- Reduced Cost
- Processing Power
- Improved Network Technology
- Size Scalability (physical & application)
- Enhanced Availability (failure management)
- Fast Communication (networks & protocols)
- Load Balancing (CPU, Net, Memory, Disk)
- Security and Encryption (clusters of clusters)
- Manageability (admin. And control)
- Programmability (simple API if required)
- Applicability (cluster-aware and non-aware app.)

.Disadvantages of cluster computing

- Hard to manage
- Gets complicated as the size of the cluster increases
- The configuration of every cluster should be same.

Applications of cluster computing

- It can be implemented in weather modeling
- Stands as support in-vehicle breakdown and nuclear simulations
- Used in image processing and in electro-magnetics too
- Perfect to be used in the applications of astrophysics, aerodynamics and in data mining
- Assist to solve complex computational problems
- Holds the flexibility to allocate workload as small data portions and which is called grid computing.
- Cluster computing has the capacity to function in many web applications such as Security, Search Engines, Database servers, web servers, proxy, and email.
- There are life savior applications through this approach like they can forecast the occurrence of earthquakes or tornadoes.