PANIMALAR INSTITUTE OF TECHNOLOGY

Department of Computer Science and Engineering

Academic Year: 2019- 2020 (Odd Semester)

Degree, Semester & Branch: VII Semester B.E. Computer Science and Engineering
Course Code & Title: CS6703 Grid and Cloud Computing
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Innovative practice: Warm-up Activities

Topic: Clusters of Cooperative Computers

Uses of Warm-up Activities:

- It helps the students to recall the previous day's class.

Procedure to use Class Polling:

- Ask one of the student to come front and ask to write one or two words which he/she was studied previous class.
- Once he/she wrote he/ she is going to tell more information which is related to that word that was covered on last class.

Topic Covered:

Clusters of Cooperative Computers

A computing cluster consists of interconnected stand-alone computers which work cooperatively as a single integrated computing resource.

- In the past, clustered computer systems have demonstrated impressive results in handling heavy workloads with large data sets.

Cluster Architecture is cluster built around a low-latency, high bandwidth interconnection network. This network can be as simple as a SAN or a LAN (e.g., Ethernet).

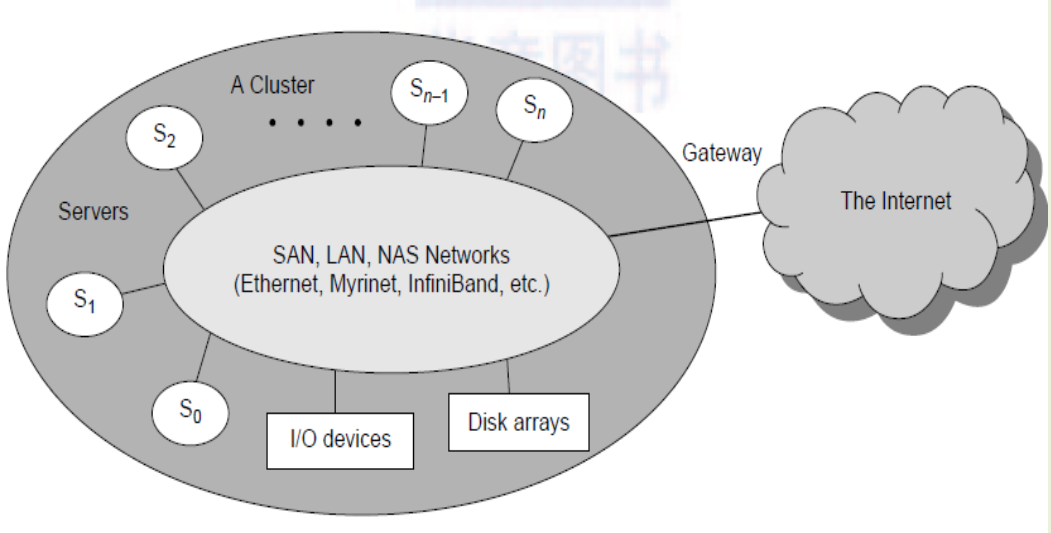


Figure 1 A Cluster of Servers interconnected by a high speed LAN or SAN with shared I/O devices and Disk Arrays

- To build a larger cluster with more nodes, the interconnection network can be built with multiple levels of Gigabit Ethernet, or InfiniBand switches.
- Through hierarchical construction using a SAN, LAN, or WAN, one can build scalable clusters with an increasing number of nodes. The cluster is connected to the Internet via a virtual private network (VPN) gateway.
- The gateway IP address locates the cluster. The system image of a computer is decided by the way the OS manages the shared cluster resources.

Most clusters have loosely coupled node computers. All resources of a server node are managed by their own OS. Thus, most clusters have multiple system images as a result of having many autonomous nodes under different OS control.

Single-System Image(SSI)

- Ideal cluster should merge multiple system images into a single-system image (SSI).
- Cluster designers desire a cluster operating system or some middleware to support SSI at various levels, including the sharing of CPUs, memory, and I/O across all cluster nodes.

An SSI is an illusion created by software or hardware that presents a collection of resources as one integrated, powerful resource. SSI makes the cluster appear like a single machine to the user. A cluster with multiple system images is nothing but a collection of independent computers.

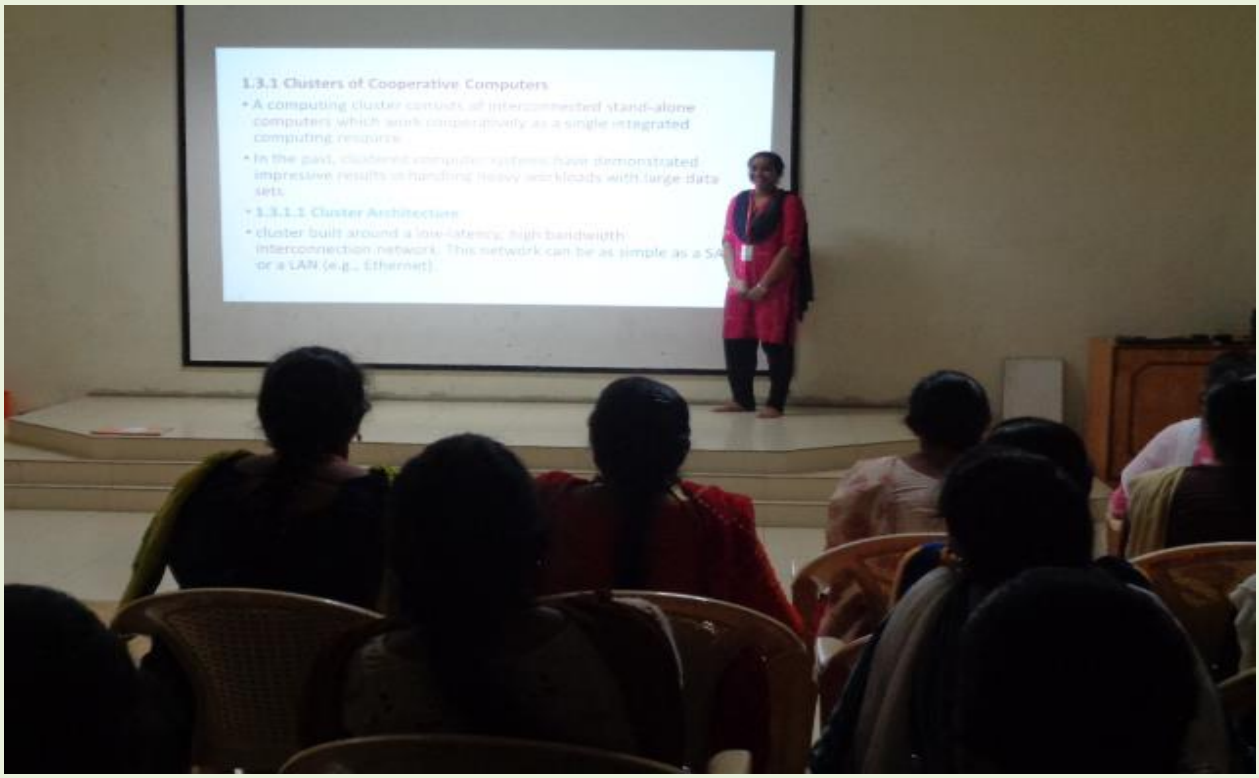
Hardware, Software, and Middleware Support

- Clusters exploring massive parallelism are commonly known as MPPs. Almost all HPC clusters in the Top 500 list are also MPPs.
- The building blocks are computer nodes (PCs, workstations, servers, or SMP), special communication software such as PVM, and a network interface card in each computer node.

Most clusters run under the Linux OS. The computer nodes are interconnected by a high-bandwidth network (such as Gigabit Ethernet, Myrinet, InfiniBand, etc.). Special cluster middleware supports are needed to create SSI or high availability (HA). Both sequential and parallel applications can run on the cluster, and special parallel environments are needed to facilitate use of the cluster resources. For example, distributed memory has multiple images. Users may want all distributed memory to be shared by all servers by forming distributed shared memory (DSM). Many SSI features are expensive or difficult to achieve at various cluster operational levels. Instead of achieving SSI, many clusters are loosely coupled machines. Using virtualization, one can build many virtual clusters dynamically, upon user demand.

Major Cluster Design Issues

- Unfortunately, a cluster-wide OS for complete resource sharing is not available yet. Middleware or OS extensions were developed at the user space to achieve SSI at selected functional levels.
- Without this middleware, cluster nodes cannot work together effectively to achieve cooperative computing. The software environments and applications must rely on the middleware to achieve high performance.
- The cluster benefits come from **scalable performance, efficient message passing, high system availability, seamless fault tolerance**, and cluster-wide job management.


1.3.1 Clusters of Cooperative Computers
• A computing cluster consists of interconnected stand-alone computers which work cooperatively as a single integrated computing resource.
• In the past, clustered computer systems have demonstrated impressive results in handling heavy workloads with large data sets.
• 1.3.1.1 Cluster Architecture
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