

Introduction

1 Explain the Demand For Computational Speed. Why do we need parallel computers and clusters.

=> Demand For Computational Speed:

The Demand For Computational speed arises From the need to process large volumes of data and solve complex problemes.

Provides high-performance within a reasonable amount of a time.

(1) Handling Complex Problems: Used to calculate advanced scientific problem data in less time.

(2) Real-Time Applications: Critical Healthcare diagnostics and autonomous vehicals required instant data processing.

(3) Big Data Analysis: Huge datasets generated by IoT, social media require rapid computation.

(4) Scientific Simulations: Fields like physics, biology and engineering use computational models that require high speeds.

(5) Complexity of Modern Problems: Applications in fields like weather forecasting, AI and cryptography require immense computational power.

=> Need of Parallel Computers and Clusters:

This are the main need of Parallel Computer and Clusters:

1. Increased Efficiency:

Parallel Computer divide tasks into smaller chunks and process them simultaneously across multiple processors can reduced the time.

Clusters achieve similar results by connecting multiple computers to work together as a single system.

2 Scalability:

Parallel computers and clusters allow for the addition of more processors or nodes to increased workloads.

3 Handling Large Data Sets:

Both system are capable of processing massive amounts of data concurrently.

4 Resource Utilization:

Optimizes the use of multiple processor or nodes to execute different parts of a program.

5. Cost Efficiency:

Combines multiple processors and nodes to achieve results similar to expensive supercomputers.

2 Explain Types of Parallel Computers with their Diagram.

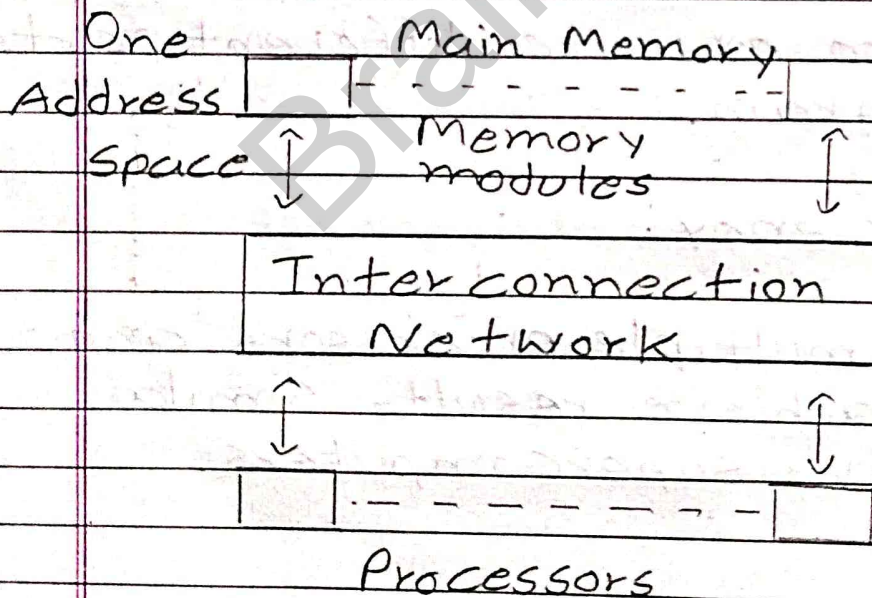
=> There are two types of Parallel Computer.

- 1) Shared Memory Multiprocessor
- 2) Distributed-memory multicomputer.

1 Shared Memory Multiprocessor:

Each Processor can ~~access~~ access any module in a shared memory configuration.

It is a system where multiple processor share access to the main memory.

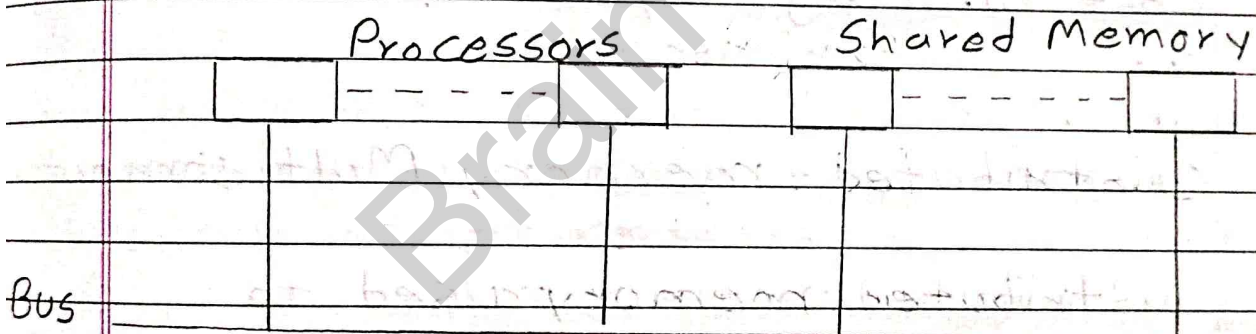


Uses an Interconnection network to connect processor and memory modules.

Each memory location has a unique address, forming a single address space accessible by all processors.

(ci) Uniform Memory Access (UMA):

- In this system, All Processors access memory with equal latency and bandwidth.
- Typically used in small systems with simple interconnections, such as bus-based structures.



(cii) Non-Uniform Memory Access (NUMA):

- Access times depend on the memory's physical proximity to the processor.
- Used in large system with distributed memory architecture.

→ Advantages :

- 1 Ease of Data Sharing
- 2 Simplified Programming Model
- 3 Flexibility in System Design

→ Disadvantages :

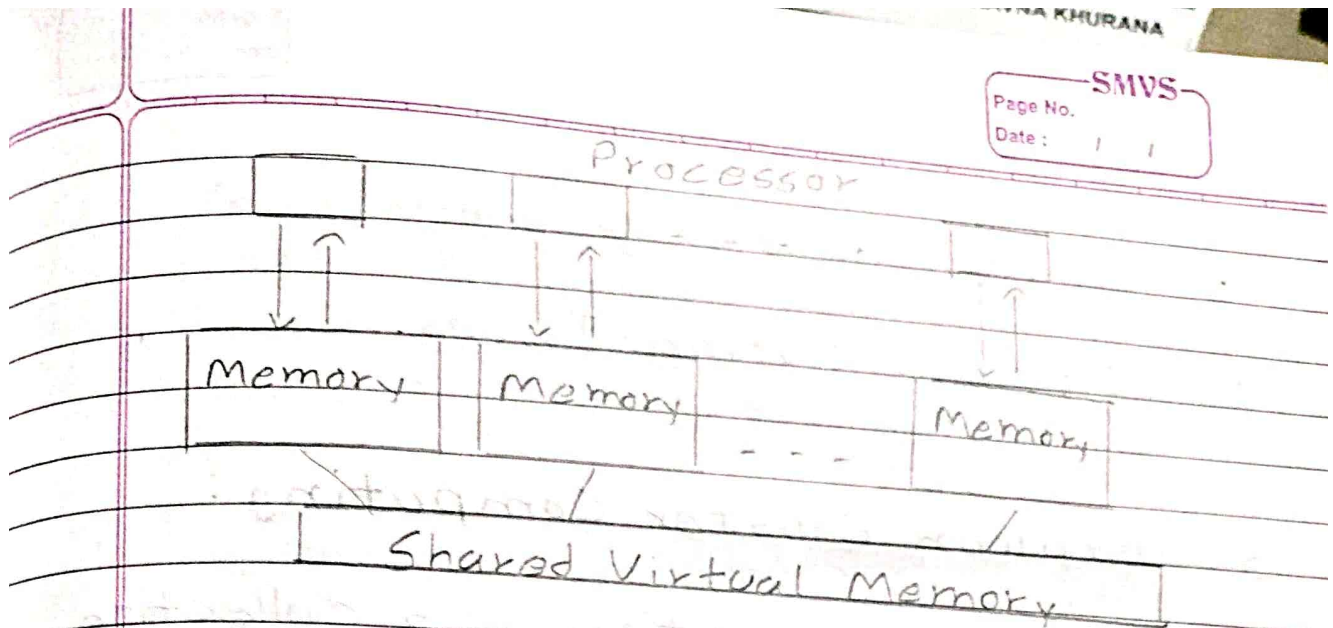
- 1 Scalability Challenges
- 2 Power and Energy Consumption
- 3 Cost for Large Systems.

2. Distributed-memory Multicomputer

Distributed memory used to address difficulties associated with message passing.

Memory is shared or distributed physically across processors but logically shared.

A Global Address space is provided.



Every Processor access time is varies based on location.

Also it used Shared Virtual Memory to manage its local memory hierarchy.

The Local memory becomes part of the shared memory and accessible from all processors.

-> Advantages:

1 Ease of Programming

2 Scalability

3 Cost Effectiveness

-> Disadvantages:

1 Complex Implementation

2 Performance Overhead

3 Synchronization Issues.

3 Explain Cluster Computing :

=> Cluster Computing is a collection of a tightly or loosely connected computers working together as a single entity.

The clusters are typically connected through fast local area networks.

Cluster Computing provides a less expensive solution to meet large-scale computational needs.

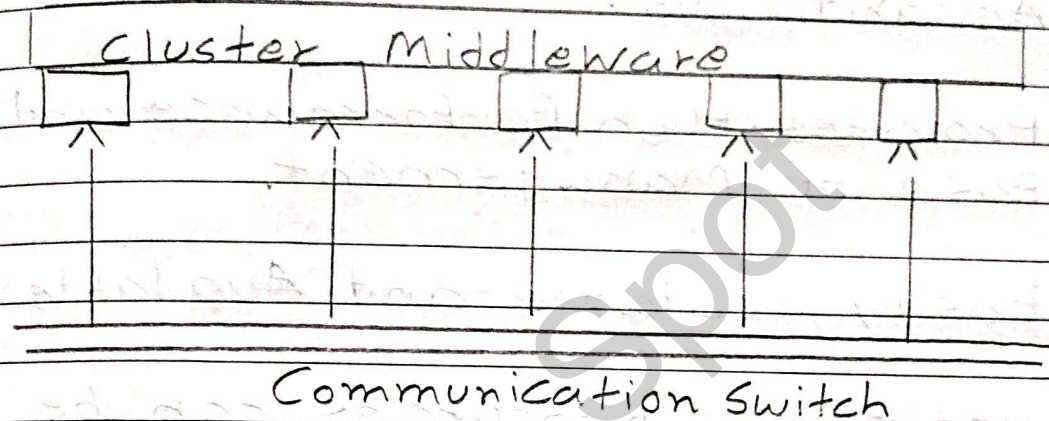
Enhances scalability, availability and resource management for organizations.

-> Cluster Computing Architecture:

The Architecture consists of interconnected individual computers functioning as a single integrated system.

Sequential Application	Parallel Applications
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Parallel Programming Environments



Here, Each nodes includes a processor, memory and other components.

Nodes are linked through high speed LAN Connection or communication Line.

Cluster Middleware or Operating System manages and coordinate task across nodes.

→ Classification of Cluster :

(i) Open Cluster : Requires IP addresses for all nodes.

cii) Closed Cluster: Nodes are hidden behind a gateway Node, which increased security.

→ Advantages:

- 1 Provides High Performance and Ease of Management.
- 2 Easily Scalable and Available
- 3 Additional Resources can be add easily.

→ Disadvantages:

- 1 Required Hardware to manage and create.
- 2 Difficult to identify the Faulty components From the system.