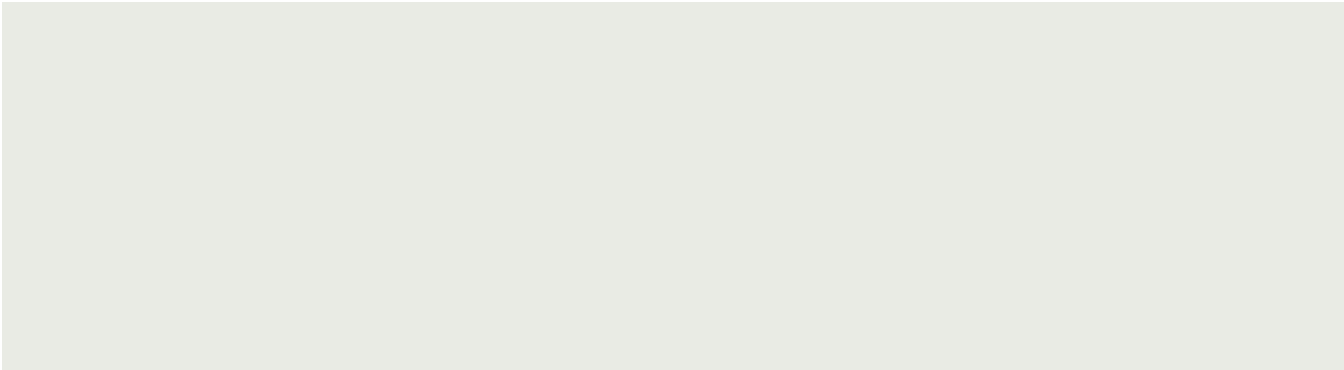

Multi-Processor Systems Distributed Systems



Multiprocessor & Distributed Systems

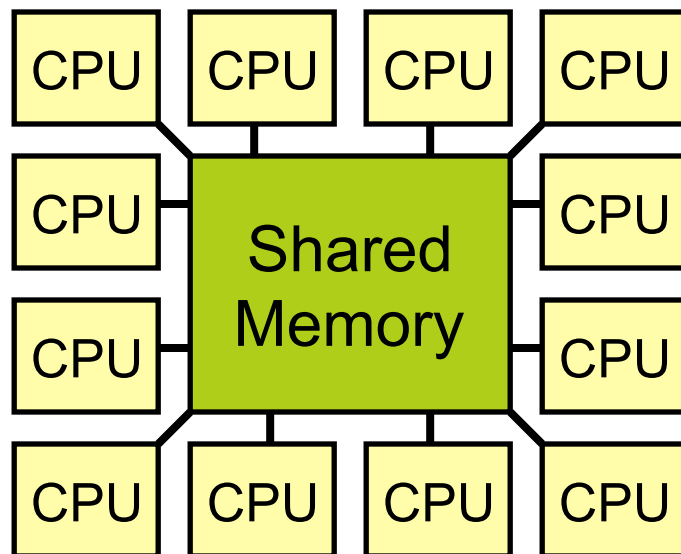
- Motivation: CPU Speed is nearing limits
 - at 10 Ghz, light signals travel 2cm
 - at 100 Ghz, no more than 2mm
 - at 1,000 Ghz, limit is 2 micro meters

- Barring an industry changing discovery, we can't build chips this small -
 - Even if we could, heat dissipation is larger problem
 - Solution: Use more chips!

Multi-processor and Distributed Systems

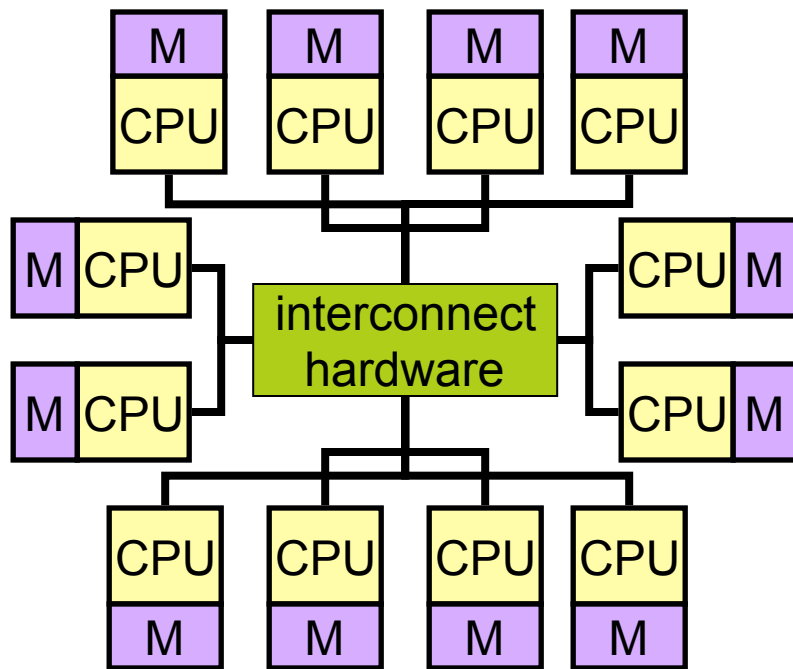
- Three basic classes:
 - Multiprocessor, Shared Memory
 - Multi-computer, Message Passing
 - Wide area Distributed Systems

Multiprocessor Systems



- How do we synchronize access to memory (data structures) ?
- Which CPU hosts the OS?
- Scheduling Processes

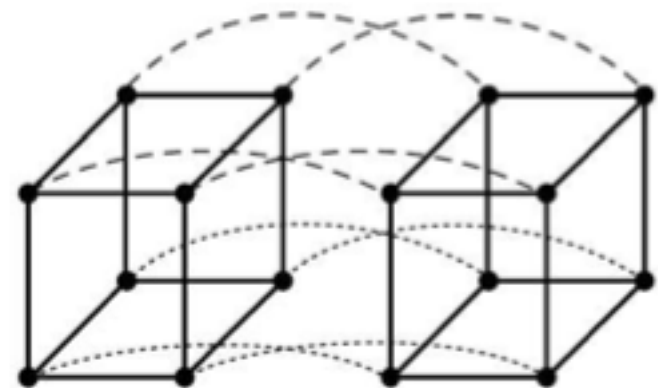
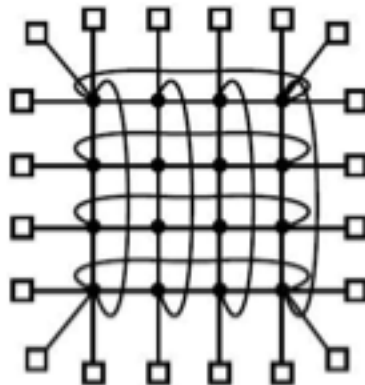
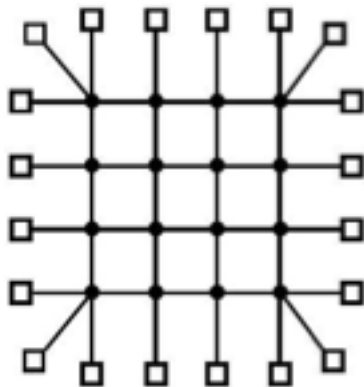
Multi-Computer



- Each *node* has own memory.
 - Separate OS
- Interconnection schemes
- Message Passing and Communication Techniques

Multi-Computer Interconnect

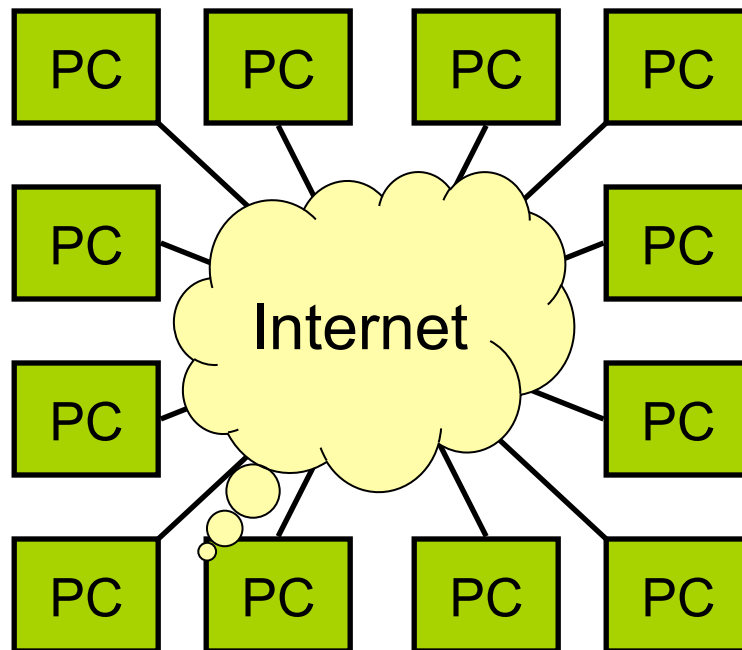
- The *distance* (# of nodes) determines communication speed
 - Star (utilizes central switch)
 - Ring
 - Others:



Message Passing

- No shared memory, communication accomplished by sending *messages*.
 - OS provides *send/recv* system calls
- In some systems, send/receive calls are made directly
- Other systems hide this - RPC
- Still others implement distributed memory (as a layer on top of message passing)

Distributed Systems



each node is full PC

- ▣ Nodes are loosely associated.
- ▣ Network Addressing
- ▣ Packet Transport
- ▣ High-Level communication

Web Services

- Web Services are nothing more than RPC over the internet - with a little more flexibility:
 - Key features:
 - Server (node) advertises a number of services it provides
 - Think of this as a header file, showing you what functions are available
 - Clients and Servers communicate in a well-known, plain text, agreed upon format (parameters, return values)
 - The result is that clients need not know any details about the server's implementation:
 - Not the OS, not the author, not even the programming language...

Summary

<u>Item</u>	<u>Multiprocessor</u>	<u>Multi-Computer</u>	<u>Distributed System</u>
Node Configuration	CPU	CPU, RAM, net interface	Complete PC
Nore Peripherals	All Shared	Shared except disk	Full set per node
Location	Same rack	Same Room	Anywhere
Internode Communication	Shared RAM	Dedicated Interconnect	Internet
Operating System	One, Shared	Multipe, same	Possibly all different
File System	One, Shared	One, Shared	Separate