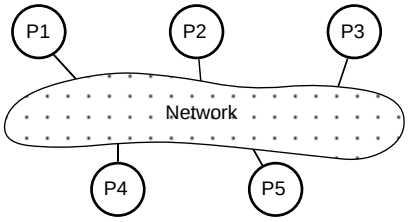
What is a Distributed System?

- From various textbooks:
  - "A distributed system is a collection of independent computers that appear to the users of the system as a single computer."
  - "A distributed system consists of a collection of autonomous computers linked to a computer network and equipped with distributed system software."
  - "A distributed system is a collection of processors that do not share memory or a clock."
  - "Distributed systems is a term used to define a wide range of computer systems from a weakly-coupled system such as wide area networks, to very strongly coupled systems such as multiprocessor systems."

What is a Distributed System? (cont.)

- A *distributed system* is a set of physically separate processors connected by one or more communication links



  - Workstation = computer = machine = processor = host = site = node
- Is every system with >2 computers a distributed system??
  - File server, printer server, web server
  - Beowulf-style cluster of workstations
  - 16-processor Cray SV1 at OSC
  - How does a distributed system differ from a parallel system?

Two Taxonomies for Classifying Computer Systems

- Michael Flynn (1966)
  - SISD — single instruction, single data
  - SIMD — single instruction, multiple data
  - MISD — multiple instruction, single data
  - MIMD — multiple instruction, multiple data
- More recent (Stallings, 1993)

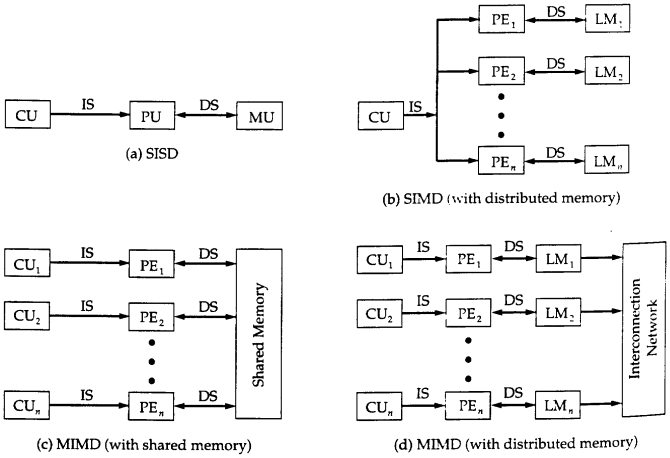
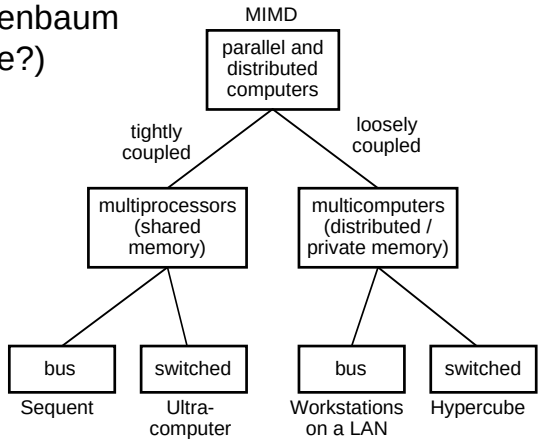


FIGURE 16.16. Alternative Computer Organizations

Classification of MIMD Architectures

- Tanenbaum (date?)



- Tightly coupled ≈ *parallel processing*
  - Processors share clock and memory, run one OS, communicate frequently
- Loosely coupled ≈ *distributed computing*
  - Each processor has its own memory, runs its own OS (?), communicates infrequently

Classification of Operating Systems

- Network Operating System
  - Loosely-coupled hardware
  - Loosely-coupled software
    - Each computer runs its own OS
    - User knows which machine he/she is on
  - Goal: share resources, provide global (network) file system
  - Typical utility programs: rlogin, rcp, telnet, ftp
- Multiprocessor Operating System
  - Tightly-coupled hardware
    - All memory is shared
  - Tightly-coupled software (single OS)
    - A process can run on any processor, OS will "balance" load across processors
  - File system similar to that on non-distributed systems

Classification of Operating Systems (cont.)

- "True" Distributed Operating System
  - Loosely-coupled hardware
    - No shared memory, but provides the "feel" of a single memory
  - Tightly-coupled software
    - One single OS, or at least the feel of one
  - Machines are somewhat, but not completely, autonomous