Model Answer

Question One (10 Marks/ 1 each)

For each of the following statements, choose the Correct Answer from the Multiple-Choice List.

1.1 The distributed system is a collection of
a) loosely coupled software on tightly coupled hardware
b) Loosely coupled hardware on tightly coupled software
c) Tightly coupled hardware on loosely coupled software

1.2 The capability of a system to adapt the increased service load is called
a) **Scalability** b) Tolerance c) Capacity

1.3 Data inconsistency occurs due to _____.
a) **Concurrent access to shared data**
b) Access on inconsistent data
c) Time clash on access of data

1.4 Multi processor system that computer system have are also called
a) Parallel systems
b) Tightly coupled system
c) **both a and b**

1.5 Which technique is based on compile-time program transformation for accessing remote data in a distributed-memory parallel system?
a) Cache coherence scheme
b) **Computation migration**
c) **R**emote procedure call

1.6 There is no need to establish and terminate a connection through open and close operation in
a) **Stateless file service**
b) **S**tateful file service
c) both (a) and (b)

1.7 Which of the following are not content of IPC message structure:
a) Actual data and number of byte
b) S**equence number or message ID**
c) Sending process address

1.8 In the token passing approach of distributed systems, processes are organized in a ring structure
a) **Logically**
b) Physically
c) both (a) and (b)

1.9 What are the characteristics of tightly coupled system? (Choose two)

a) **Same clock, usually shared memory**
b) Different clock
c) Communication is via this shared memory

1.10 In distributed systems, election algorithms assumes that

a) there is no priority number associated with any process
b) priority of the processes is not required
c) a unique priority number is associated with each active process in system

Question Two (49 Marks)

2.1. List the key design goals of distributed system? **What** are the disadvantages of it? (5 Marks/ 2.5 each)

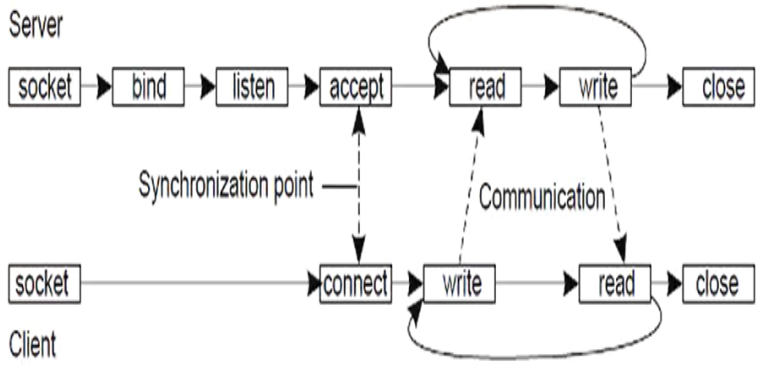
Goals are:

- Take advantage of cost/performance difference between microprocessors and shared memory multiprocessors
- Build systems:
    1. with a single system image
    2. with higher performance
    3. with higher reliability
    4. for less money than uniprocessor systems
- In wide-area distributed systems, information and work are physically distributed, implying that computing needs should be distributed. Besides improving response time, this contributes to political goals such as local control over data.
- Making Resources Accessible
- Distribution Transparency
- Communication
- Flexibility
- To coordinate the use of shared resources
- To solve large computational problem

Disadvantages are:

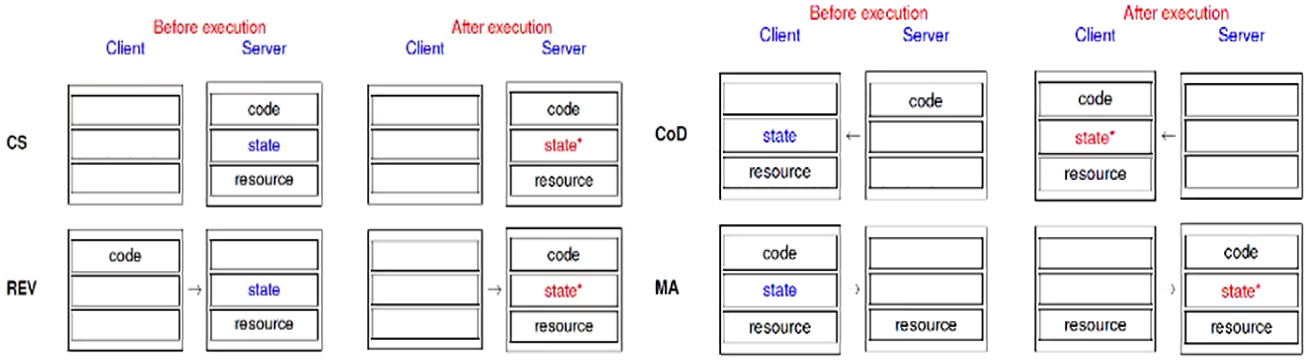
- Complexity :-
    - Lack of experience in designing, and implementing a distributed system. E.g. which platform (hardware and OS) to use, which language to use etc.
- Network problem:-
    - If the network underlying a distributed system saturates or goes down, then the distributed system will be effectively disabled thus negating most of the advantages of the distributed system.
- Security:-
    - Security is a major hazard since easy access to data means easy access to secret data as well.

2.2. Sketch the Connection-oriented communication pattern using sockets. (3 Marks)



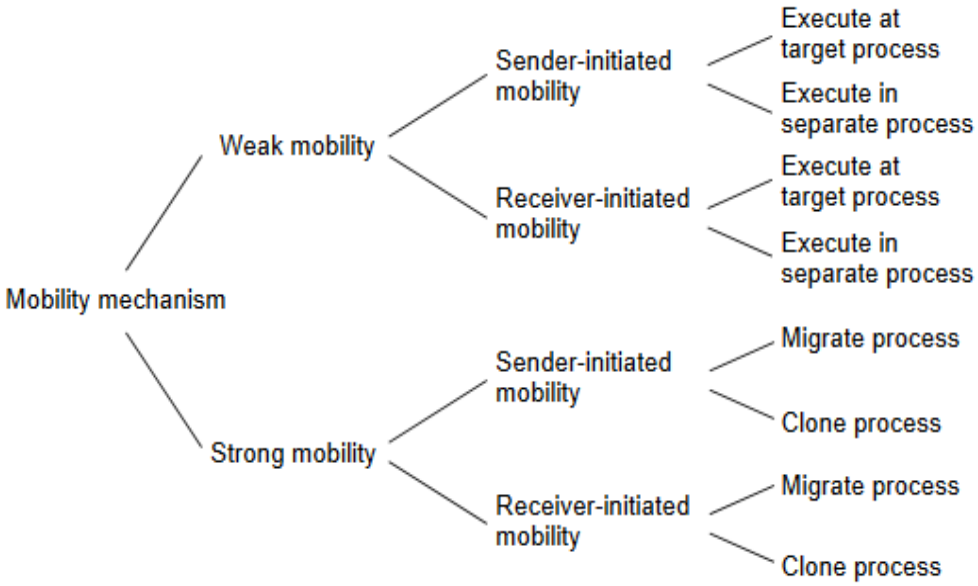
2.3. **Discuss** in short the available models for Code Migration. **Use** figures to support your answer. (10 Marks)

- CoD: Code-on.demand
- MA: Mobile Agents
- CS: Client-Server
- REV: Remote evaluation

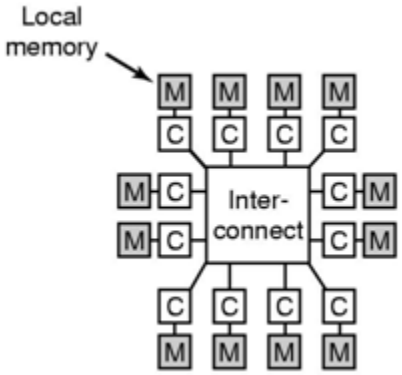


2.4. **Compare** between each of the following : (20 Marks/ 5 each)

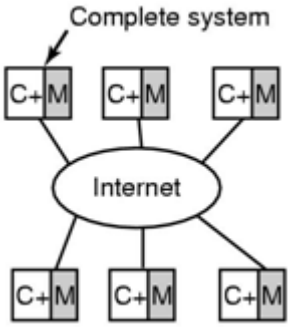
- *weak* and *strong* mobility.



- *Closely and loosely coupled* system.
  - Distributed system becomes more "closely coupled" as it:
    - appears more uniform in nature
    - runs a "single" OS (cooperating across all machines)
    - has a single security domain
    - shares all logical resources (e.g., files)
    - shares all physical resources (CPUs, memory, disks, printers, etc.)



  - *Loosely coupled systems*
    - Most distributed systems are "loosely-coupled
    - Each CPU runs an independent autonomous OS
    - Hosts communicate through message passing.
    - Computers/systems don't really trust each other
    - Some resources are shared, but most are not
    - The system may look differently from different hosts
    - Typically, communication times are long
      - Relative to processing times



2.5. Discuss in short the System Architectures for Distributed Systems. (3 Marks)

- Centralized: traditional client-server structure
  - Vertical (or hierarchichal) organization of communication and control paths (as in layered software architectures)
  - Logical separation of functions into client (requesting process) and server (responder)
- Decentralized: peer-to-peer
  - Horizontal rather than hierarchical comm. and control

- Communication paths are less structured; symmetric functionality
- Hybrid: combine elements of C/S and P2P
  - Edge-server systems
  - Collaborative distributed systems.

2.6. What's Multiprocessor. **Discuss** in short the types of Multiprocessors' OS. (2+6 Marks)

- ***Multiprocessor*** is A computer system in which two or more CPUs share full access to a common RAM
- *Private OS*
- Master-Slave
- *Symmetric Multi-Processor (SMP)*

Question Three (16 Marks)

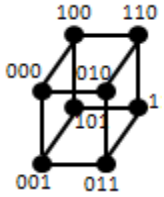
3.1. Find the speedup and cost of a parallel system consists of *four* processor elements, where the execution time is in the table shown below: (3 Marks)

	1 *CPU*	**2 *CPU***	**4 *CPU***	**8 *CPU***
T(p)	150	72	30	12

$$S(p) = \frac{T(1)}{T(p)}$$

$$\textbf{\textit{Cost}} = p \times T_p$$

3.2. Draw a 3-D hypercube network. **Calculate** its *no. of nodes, node degree*, *network diameter*, and *bisection width*. (2+4 Marks)



Network type	Node degree, d	Network diameter, D	No. of links, l	Bisection width, B	Symmetry	Remarks on network size
Hypercube	n	n	$nN/2$	$N/2$	Yes	N nodes, $n = \log_2 N$ (dimension)

No. of nodes=2^3=8
Node degree= 3
Network diameter= 3
Bisection width= 8/2=4

3.3. **Give** short definition of distributed algorithm. **Design** a flooding algorithm for broadcast. The initiator sends a Flood message, with a unique message *id* to all neighbors. The message has:

- Type Flood
- Unique id: (source id, message seq.)
- Data

- Every node *p* that receives a flood message *m*, does the following:
  - If *m.id* was seen before, discard *m*
  - Otherwise, Add *m.id* to list of previously seen messages and send *m* to all neighbors of *p*
- The initiator runs init_flood_broadcast, and the noninitiators flood_broadcast. (2+5 Marks)

A **distributed algorithm** is an algorithm, run on a distributed system, which *does not* assume the previous existence of a central coordinator.

Best Wishes & Good Luck