Lecture #1

History

1945 - 1985: Computers were large & expensive.

mid-1980s:- 2 major advances in technology.

I. Development of microprocessors.

8-bit INTEL 8080

Motorola 6800.

later 16-, 32-, & 64-bit.

Economic terms:

a m/c 10 million dollar : 1 instr/sec.

to

1000 dollar : 1 billion instr/sec.

Price/performance : 10^{13}.

if cars had such improvement

Rolls Royce would cost 1 dollar & give

1 billion miles/gallon.

II. High-speed computer networks LANs.

allow a large number of machines to be connected & transfer information between these machines in few microseconds.

↳ 100 million to 10 billion bits/sec.

WANs: 64 Kbps to 1 Gbps.

⇒ large no. of m/c interconnected m/c called Distributed/Comp systems / NW.

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Distributed System.

is a collection of independent computers that appears to its users as a single coherent system.

Properties

- autonomens.
- single system
- collaboration

- No physical clock
- No shared memory
- Geographical separation

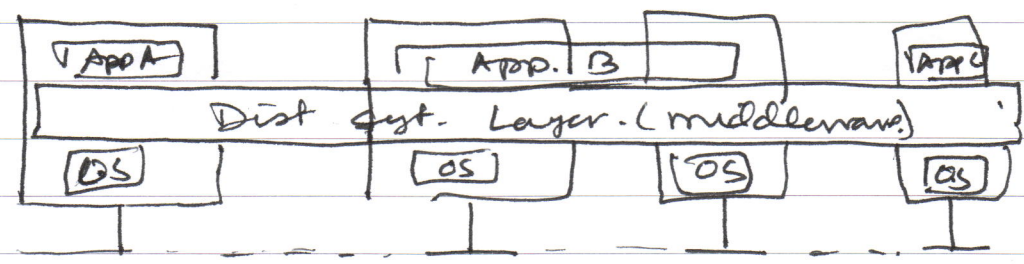
- no assumption about the type of the computer.
- no assumption as to how they are connected.

Characteristics

- how the communication occurs is hidden from the users
- user interaction in a consistent and uniform way.

Desirable goals:

- easy to expand and scale.
- continuously available, even when some parts are temporarily out-of-order.



Goals

A dist. system should make resources easily accessible; it should hide the fact that resources are distributed across a network; it should be open; and it should be scalable.

1. Making Resources Available

- Access remote resources
- Share them in a controlled and efficient way.

examples:

- printers
- storage
- data
- files.

Economy-of-scale.

Users ⟷ resources ⇒ collaboration.

2. Distribution Transparency.

A distributed system that is able to present itself as if it were a single system is TRASPARENT.

Types.

Access: hide differences in representation.
Location: ~~where~~ hide where resources is
Migration: enabling movement of resources
Relocation: migration during use.
Replication: multiple copies act as one.

· Concurrency: hide resource is shared
· Failure : hide the failure + recovery of resources

3. Openness.
- offers services according to standard rules that describe the syntax + semantics of those services.
→ defined through interfaces: Interface Definition Language (IDL).

Interoperability

Portability.

Extensibility.

4. Scalability
a. A system be scalable with respect to its size.
e.g. add more resources + users.
b. Geographically scalable is one in which users and resources may lie far apart.
c. Administratively scalable -

scalability problems.
centralized servics.: implemented as a single server. ⇒ bottleneck.

Centralized data:

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Centralized algorithms: bad idea.

↓

Distributed / Decentralized algorithms:

1. No. m/c has complete information.
2. M/c make decisions based on local info.
3. failure of one m/c should not be a show-stopper.
4. No assumption about a global clock.

synchronous vs asynchronous communication

Common Pitfalls.

1. Network is reliable
2. NW is secure.
3. NW is homogeneous
4. Topology is fixed
5. Latency is zero
6. BW is infinite
7. Transport cost is zero
8. One administrator

Challenges

Communication
- Send/Receive
- RPC
- ROI
- Message oriented vs Stream oriented

Processes
- process + thread int client/server
- Code migration

Naming:
- Complex.

Synchronization.
- mutual exclusion
- leader election
- physical clocks vs logical clocks
- global state.

Data storage + access:
- file sharing
- memory sharing.

Consistency + Replication:

Fault-tolerance.
- dealing with failures

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Newer Challenges

Mobile Systems

Sensor Networks

P2P computing

Publish-subscribe, content dist., + multimedia

Grid computing

Cloud Computing