Chapter 4
Interprocess Communication and Coordination

Summary
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What is Interprocess Communication? [1, Randy & Johnson, 1997]

- Processes communicating with each other in some form or the other.
- Significant role in Distributed Systems.

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<th>Interprocess Communication</th>
<th>Transaction</th>
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<td>Request / Reply (RPC)</td>
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Different Levels of Communication
Message Passing Communication [I, Randy & Johnson, 1997]

• Lowest level of interprocess communication.

• Generic message passing.

• send(destination, message) and receive(source, message) where source or destination = (process name, link, mailbox or port).

• Examples of Message Passing Communication are *Pipes and Sockets*. 
Pipes and Sockets [1, Randy & Johnson, 1997]

- Widely used in Unix and Windows environments.
- Unidirectional communication link.
- For example in Unix System, $ who | sort | lpr
Pipes and Sockets [1, Randy & Johnson, 1997]

- Widely used in Windows environment.
- Goals of Socket Communication are:
  - Privacy
  - Integrity
  - Authenticity.
Request / Reply Communication
Remote Procedure Calls [1, Randy & Johnson, 1997]

- Next level of communication above Message Passing.
- Most widely used model is Remote Procedure Call.
- Form of a normal procedure call, with input and output parameters.
- Execution involves delays and failures in network operations.
- Elegant way of achieving communication transparency by shielding low level system calls, data conversion and network communication.
Flow of Remote Procedure Calls

[1, Randy & Johnson, 1997]
Problems in Remote Procedure Calls [1, Randy & Johnson, 1997]

- Parameter Passing and Data Conversion
  - What types of data can be passed and how is it represented?

- Binding
  - How does a client locate server and a server register?

- Compilation
  - Where do the stub procedures come from and how are they linked?

- Exception and Failure Handling
  - How are errors reported?

- Security.
Transaction Communication

ACID Properties [1, Randy & Johnson, 1997]

- Atomicity
  - Either all operations are performed or none

- Consistency
  - Interleaved transactions execute in some order.

- Isolation
  - Incomplete results are not visible

- Durability.
  - Results of committed transactions are permanent.
Two Phase Commit Protocol

Stage 1 - Prepare
- Global Transaction
- Prepare
  - Resource Manager
  - Prepared
  - Prepare
  - Prepared

Stage 2 - Commit
- Global Transaction
- Commit
  - Resource Manager
  - Committed
  - Commit
  - Committed

Transaction Manager
Name and Directory Services
Name and Address Resolution  [1, Randy & Johnson, 1997]

- Textual Names
- Object Attributes
DISTRIBUTED MUTUAL EXCLUSION

Task 1

Task 2

Task 3

Shared Data

Mutual Exclusion
DISTRIBUTED MUTUAL EXCLUSION

• Ensures that concurrent processes make an access to the shared resources.

• Problem can be solves in 2 ways:
  • Contention Based Approach
  • Controlled Approach

• Each process equally competes for the resource by request resolution criteria.

• Criteria can be times of requests, voting, priorities etc.

• A logical token representing access right to shared resource is passed in regular fashion. Whoever holds it, is the winner.
LEADER ELECTION  [1, Randy & Johnson, 1997]

• Centralized controller would simplify the process of synchronization.

• However, it is single of failure.

• Leader Election is mainly concerned with election of unique leader process, known to all other processes in a group.

• Two basic election criteria

• Extreme Finding: Based on global priority

• Preference Based: Voting for a leader based on preferences (reliability, locality etc.)

• Leader Election and Mutual Exclusion are same in many aspects, they both try to reach an agreement in identifying the unique process.
### MUTUAL EXCLUSION vs LEADER ELECTION

[1, Randy & Johnson, 1997]

<table>
<thead>
<tr>
<th>MUTUAL EXCLUSION</th>
<th>LEADER ELECTION</th>
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<tr>
<td>• Process competes until it succeeds.</td>
<td>• Once the leader is elected, a process would return to normal execution.</td>
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<tr>
<td>• Algorithm must ensure that no process is starved</td>
<td>• Fast and successful termination of leader election process.</td>
</tr>
<tr>
<td>• A process does not care which other process is currently in critical section</td>
<td>• Result of Leader Election process must be announced to all other processes.</td>
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Most Recent Happenings
Cloud Computing - Google App Engine

- Cloud Computing is a pattern in which scalable and virtualized resources are provided as a service over the internet.

- Users need not have any knowledge of or control over the technology infrastructure in the cloud.

- Google App Engine is a Cloud Computing technology.

- It virtualizes applications across multiple servers and data centers.

- It is a platform for developing and hosting web applications in google owned data centers.

- Currently, it is free up to certain level of used resources.
Some of the vendors in Cloud Computing

[2, Cloud Computing]
It would run our own web applications on Google’s expansive infrastructure.

No licensing fee.

Easy to maintain and scale, no servers needed, just upload your application and it’s ready to serve.

Our own domain name or Google’s free appspot.com domain, share our application to the world outside.

Currently, the supported programming languages are Python and Java.

All we need is a Gmail Account.
• An early look at a very simple Java Address Book App.
Google App Engine - Restrictions

• Read Only Access to files on the App Engine.
• Sacrifice privacy and personal data to a third party.
• Limits freedom and creativity.
• Supports only HTTP requests.
• Limited usage quotas for free applications 500 MB of storage.
• 5 million visits to page per month.
• Does not support RDB.
• Shifting from RDB to Datastore.
Wi-Fi over Cellular Towers - Why is it necessary?

- Edge Network is slow and costly. AT&T - $30 per month.
- Spotty 3G Data Coverage near Bay Bridge, CA.
- Some of the apps can be downloaded only on Wi-Fi.
Verizon My-Fi - A Mobile HotSpot.

- Portable Access Point
- Works with any phone that supports Wi-Fi.
- Better data coverage.
- Connect to your Laptop on the go.
- Speed is almost similar to DSL Connection.
- Contract, Expensive $40  250 MB, No unlimited data plan.
- Share it with others 5 users limit.
Cloud Computing - The future is already here!

[6, Maggiani, 2009]

• Lower the overall cost of purchasing infrastructure.
• Avoid capital expenditure.
• Offers infrastructure, platform, software as services.
• Clients need not maintain Data Centers.
• Quick and Cheap no longer mean poor quality.
• Can’t live without RDB? Other options are available.
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References


4. Google App Engine “http://www.youtube.com/watch?v=P3GT4-m_6RQ”


Thank you.