

Operating System

Lecture 7: Inter Process Communication



Manoj Kumar Jain

M.L. Sukhadia University Udaipur

Outline

- Inter Process Communication
- Communication in Client-Server Systems

Inter Process Communication (IPC)

- Mechanism for processes to communicate and to synchronize their actions.
- Message system – processes communicate with each other without resorting to shared variables.
- IPC facility provides two operations:
 - **send**(*message*) – message size fixed or variable
 - **receive**(*message*)

IPC (Cont.)

- If P and Q wish to communicate, they need to:
 - establish a *communication link* between them
 - exchange messages via send/receive
- Implementation of communication link
 - physical (e.g., shared memory, hardware bus)
 - logical (e.g., logical properties)

Implementation Questions

- How are links established?
- Can a link be associated with more than two processes?
- How many links can there be between every pair of communicating processes?
- What is the capacity of a link?
- Is the size of a message that the link can accommodate fixed or variable?
- Is a link unidirectional or bi-directional?

Direct Communication

- Processes must name each other explicitly:
 - **send** ($P, message$) – send a message to process P
 - **receive**($Q, message$) – receive a message from process Q
- Properties of communication link
 - Links are established automatically.
 - A link is associated with exactly one pair of communicating processes.
 - Between each pair there exists exactly one link.
 - The link may be unidirectional, but is usually bi-directional.

Indirect Communication

- Messages are directed and received from mailboxes (also referred to as ports).
 - Each mailbox has a unique id.
 - Processes can communicate only if they share a mailbox.
- Properties of communication link
 - Link established only if processes share a common mailbox
 - A link may be associated with many processes.
 - Each pair of processes may share several communication links.
 - Link may be unidirectional or bi-directional.

Indirect Communication

- Operations

- create a new mailbox
- send and receive messages through mailbox
- destroy a mailbox

- Primitives are defined as:

send(A , *message*) – send a message to mailbox A

receive(A , *message*) – receive a message from mailbox A

Indirect Communication

- Mailbox sharing

- P_1 , P_2 , and P_3 share mailbox A.
- P_1 sends; P_2 and P_3 receive.
- Who gets the message?

- Solutions

- Allow a link to be associated with at most two processes.
- Allow only one process at a time to execute a receive operation.
- Allow the system to select arbitrarily the receiver. Sender is notified who the receiver was.

Synchronization

- Message passing may be either blocking or non-blocking.
- **Blocking** is considered **synchronous**
- **Non-blocking** is considered **asynchronous**
- **send** and **receive** primitives may be either blocking or non-blocking.

Buffering

- Queue of messages attached to the link; implemented in one of three ways.
 1. Zero capacity – 0 messages
Sender must wait for receiver.
 2. Bounded capacity – finite length of n messages
Sender must wait if link full.
 3. Unbounded capacity – infinite length
Sender never waits.

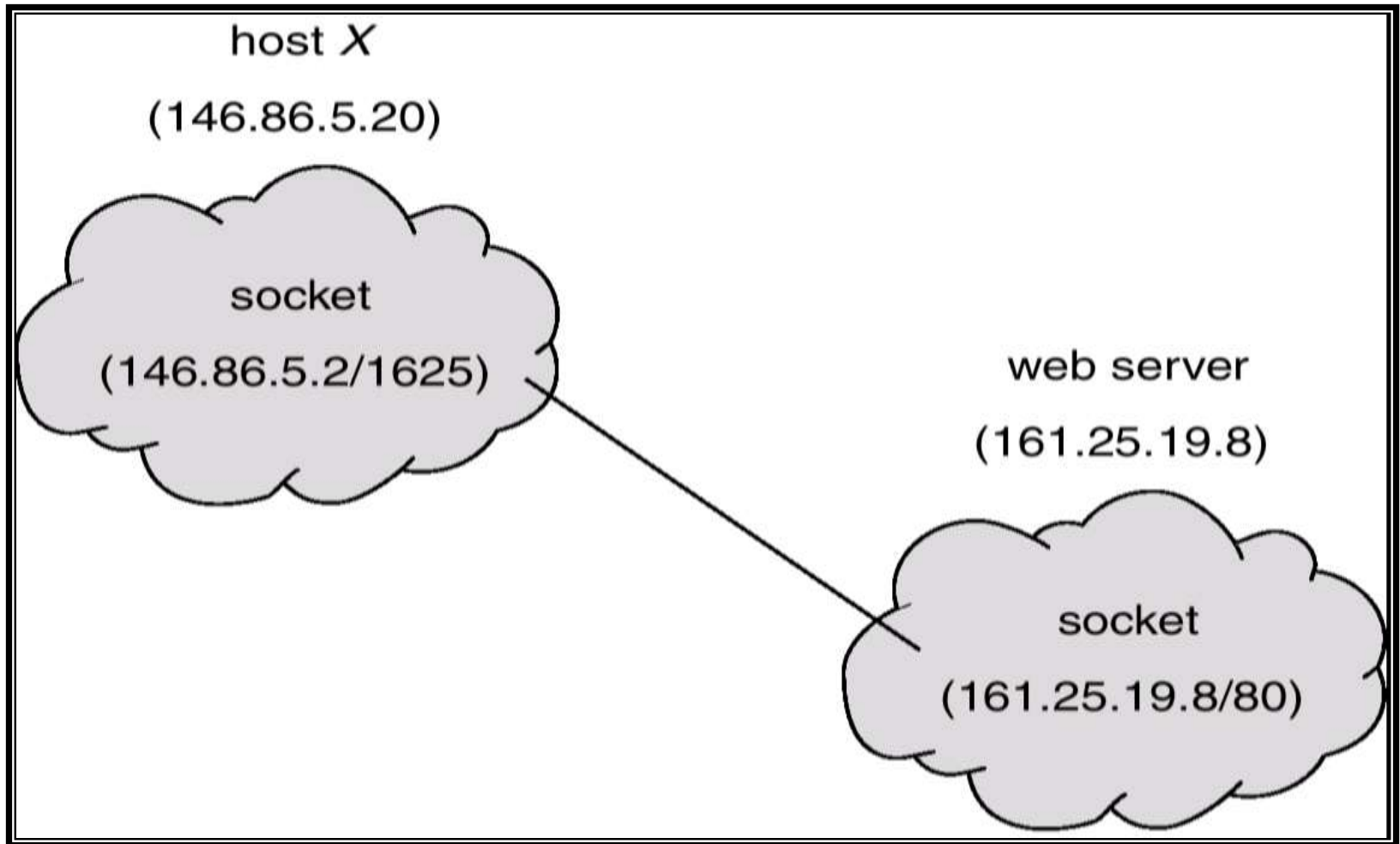
Client-Server Communication

- Sockets
- Remote Procedure Calls
- Remote Method Invocation (Java)

Sockets

- A socket is defined as an *endpoint for communication*.
- Concatenation of IP address and port
- The socket **161.25.19.8:1625** refers to port **1625** on host **161.25.19.8**
- Communication consists between a pair of sockets.

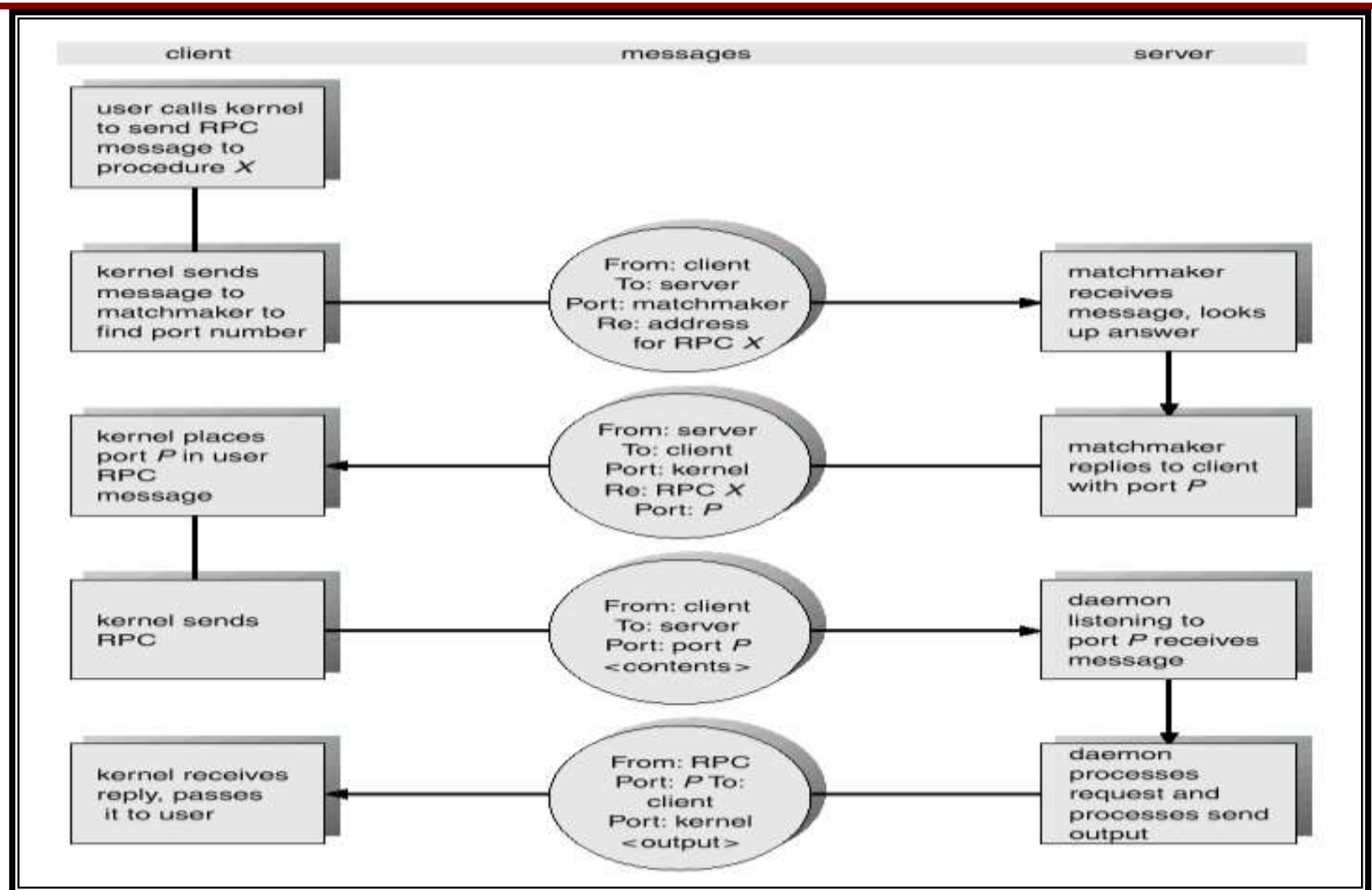
Socket Communication



Remote Procedure Calls

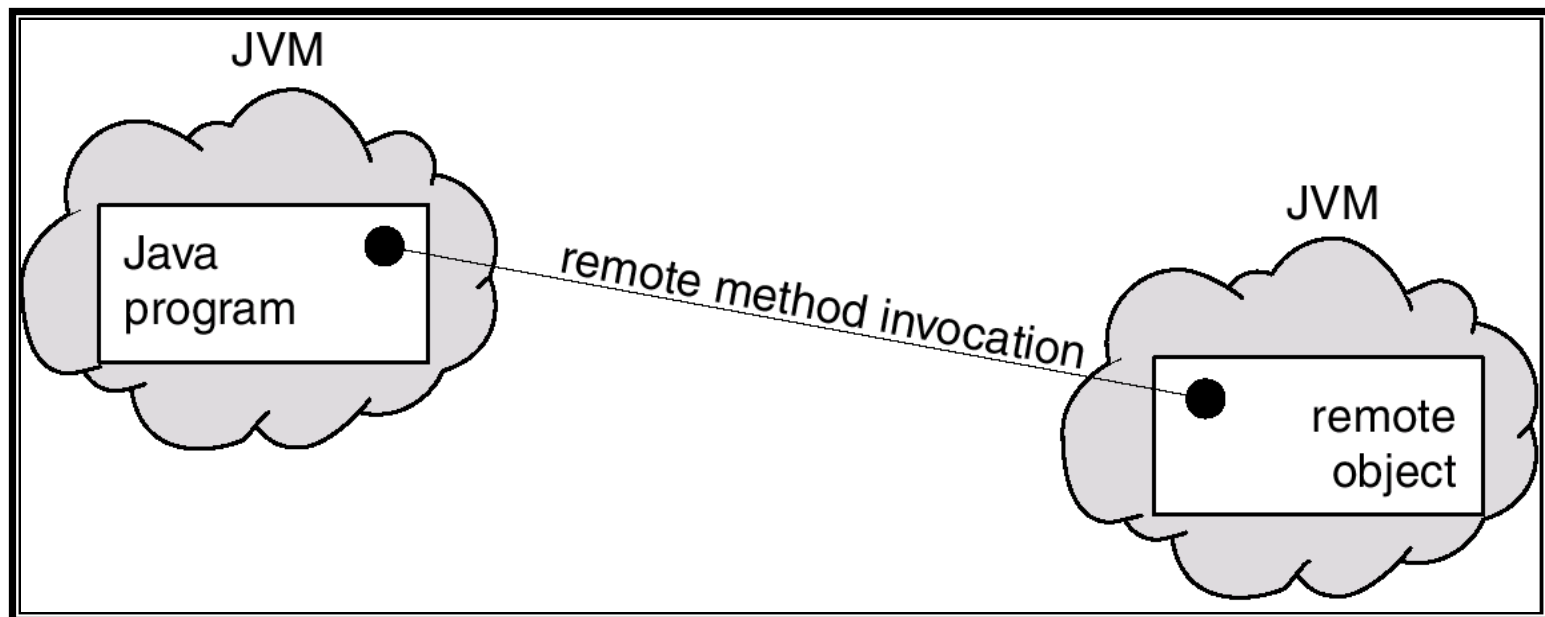
- Remote procedure call (RPC) abstracts procedure calls between processes on networked systems.
- **Stubs** – client-side proxy for the actual procedure on the server.
- The client-side stub locates the server and *marshalls* the parameters.
- The server-side stub receives this message, unpacks the marshalled parameters, and performs the procedure on the server.

Execution of RPC

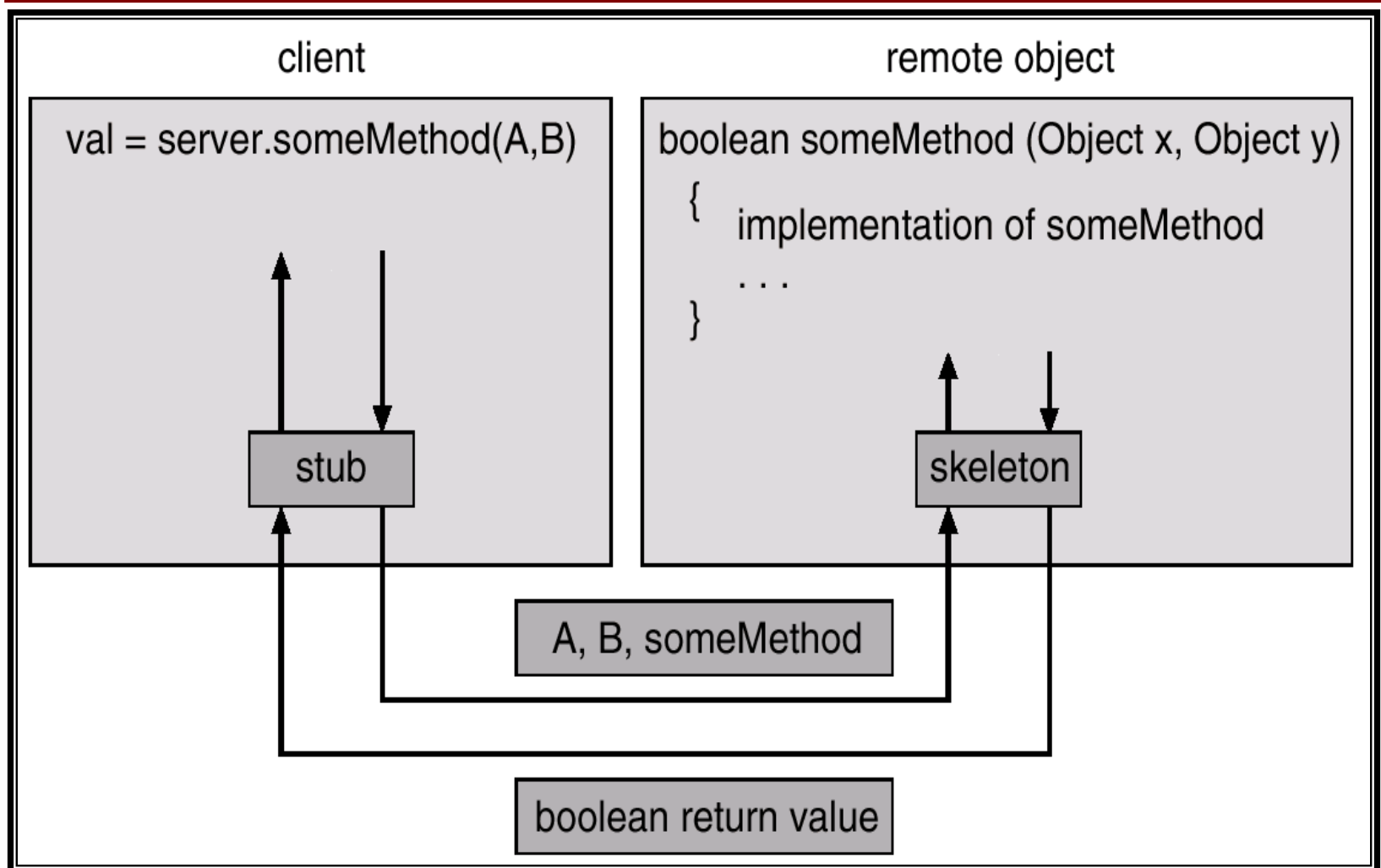


Remote Method Invocation

- Remote Method Invocation (RMI) is a Java mechanism similar to RPCs.
- RMI allows a Java program on one machine to invoke a method on a remote object.



Marshalling Parameters



Thanks