Architectural Models

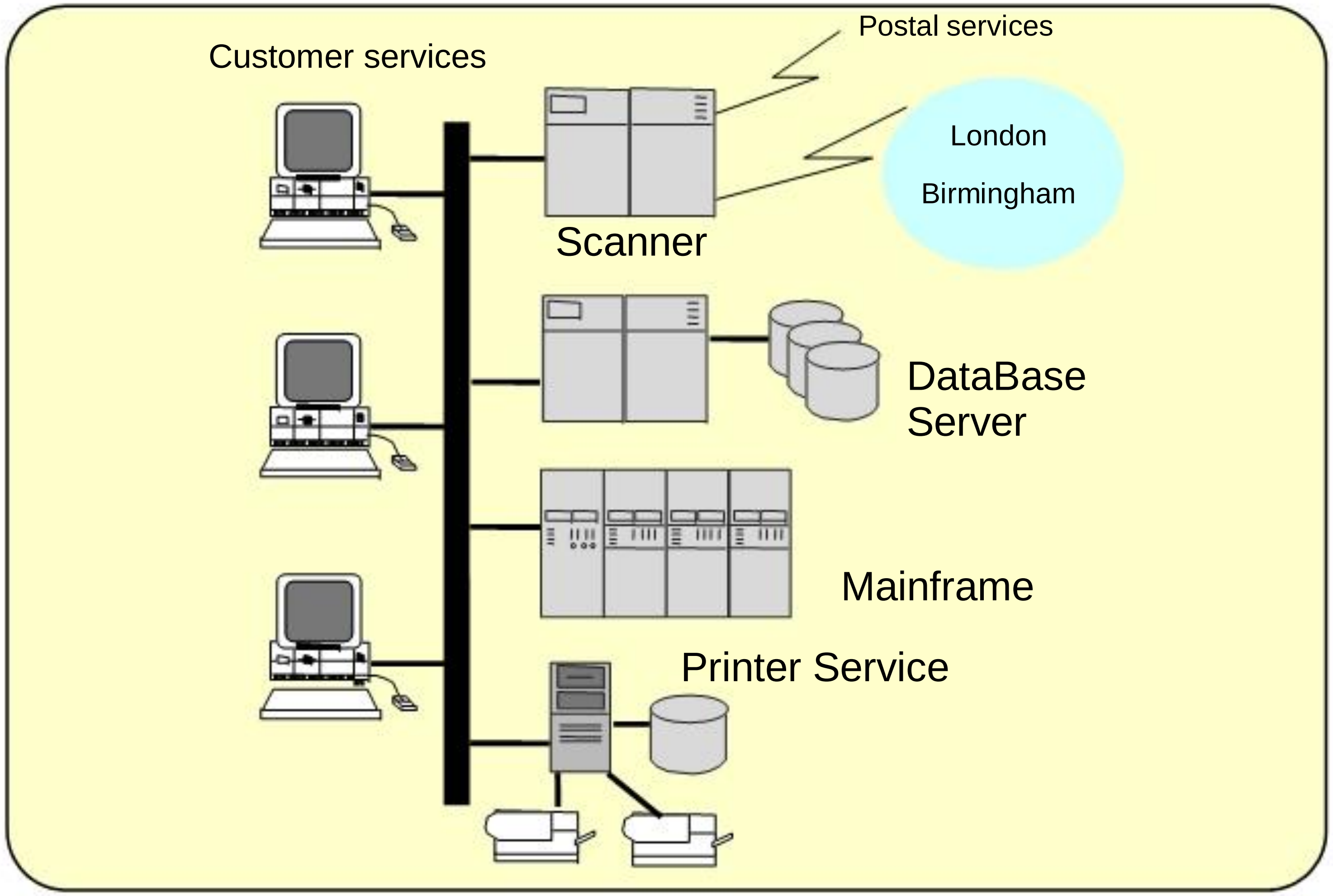
Overview

- System architectures
- Software layers
- Architectural models
  - client-server, peer processes,…
  - mobile code, agents,...
- Design requirements
  - user expectations of the system

Example: Paperless Office

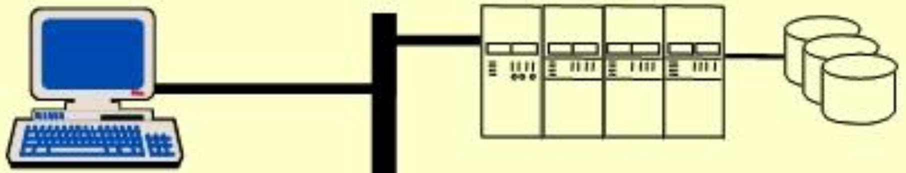
- Requirements
  - - input and storage of scanned documents
  - - viewing/printing of documents on demand
  - - networking for resource sharing and communications
  - - accounting and data analysis
- Required properties
  - - no loss/corruption/unauthorised access of data
  - - fast response
  - - should grow as the business expands

Distributed Design



Client Server Systems

One Tier Architecture

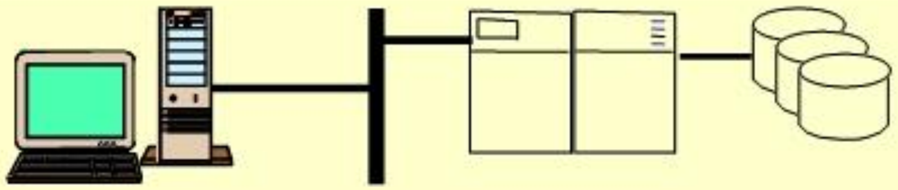


Network computer or PCs with terminal emulation

Presentation (to clients)
+ processing (transactions, applications)
+ data (management & access)

Two Tier Architecture

workstations



Client-server "fat client" or "fat server"

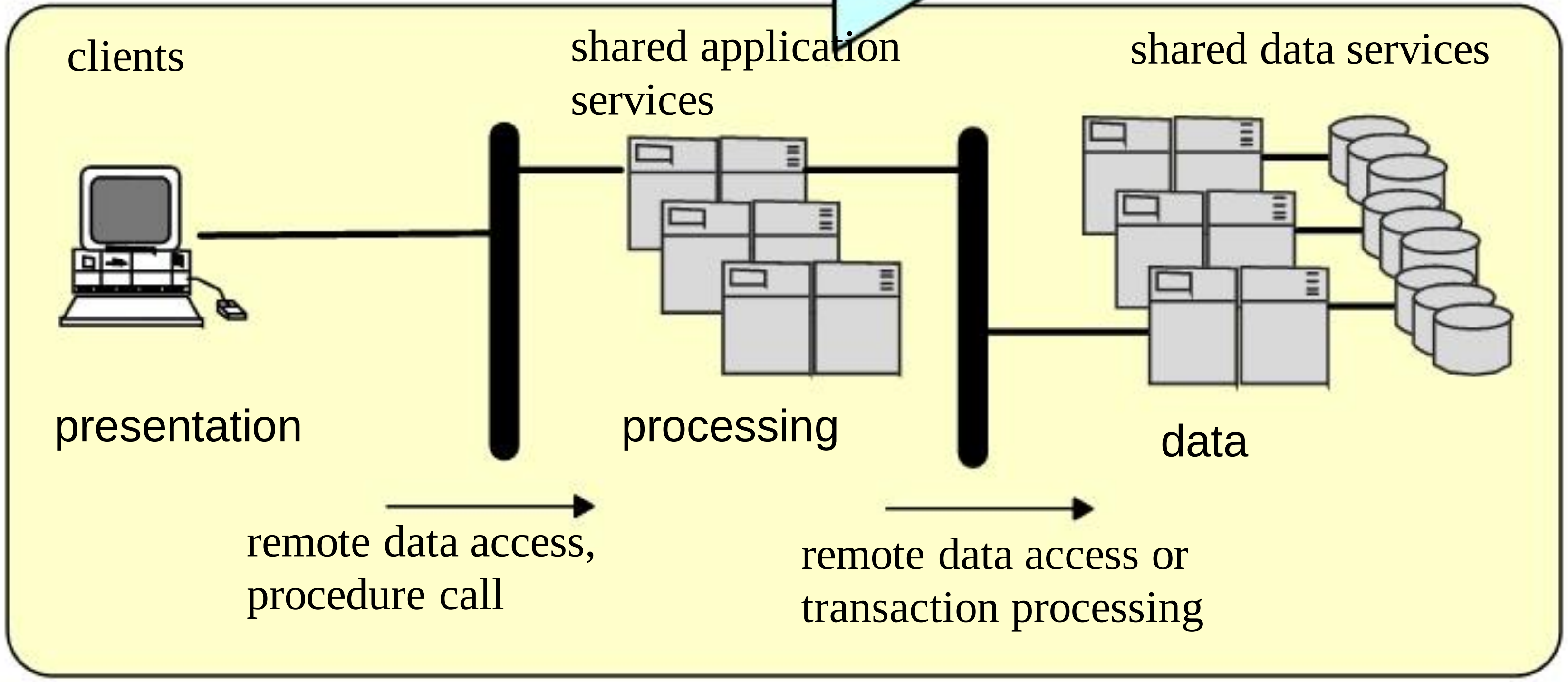
Presentation + processing ÅÆ Data (remote data access)

or presentation ÅÆ Data processing (remote procedure call)

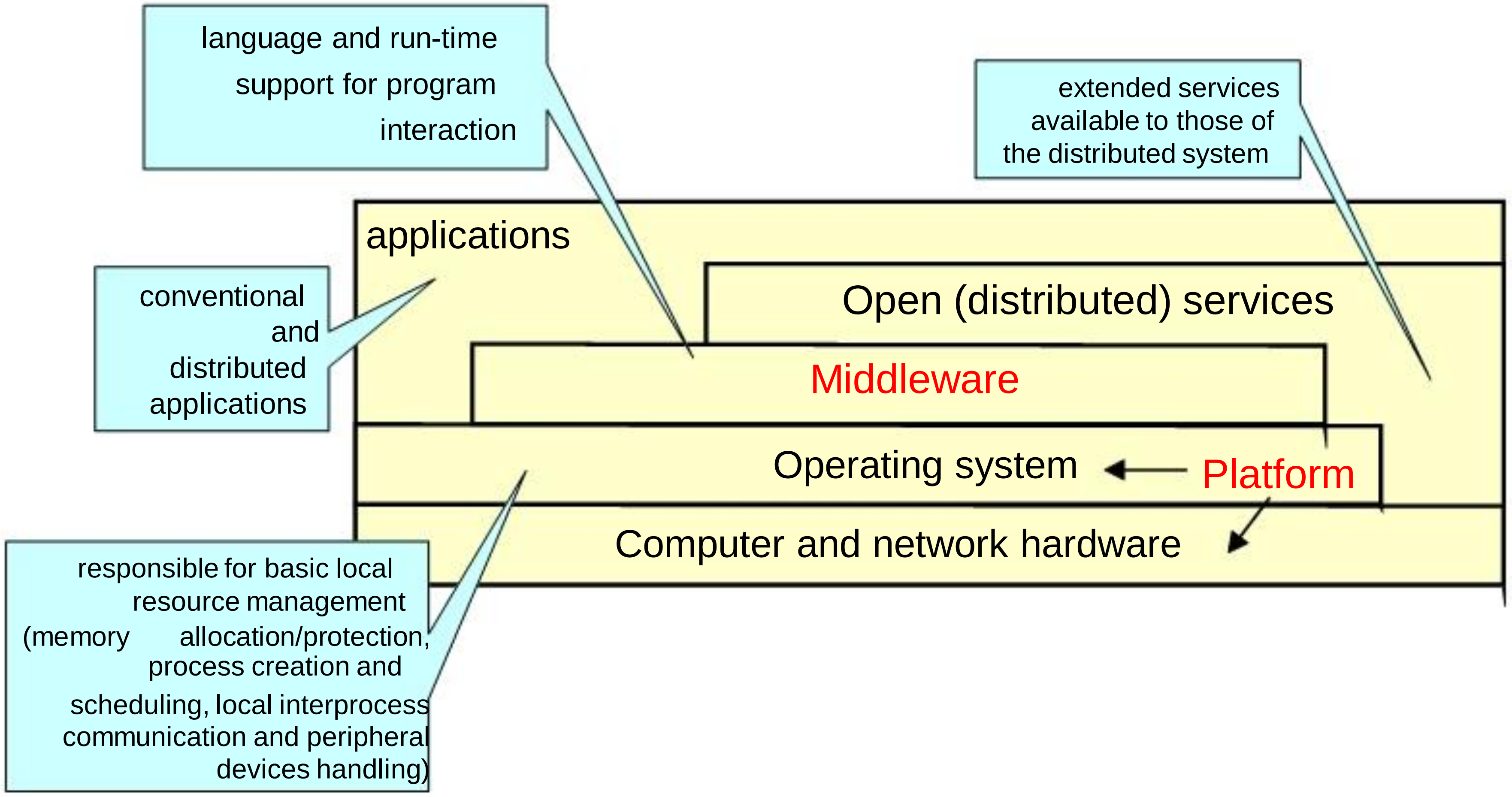
Client Server ctd

Three Tier Architecture

Two tier is satisfactory for simple client-server applications, but for more demanding transaction processing applications*...


clients
shared application services
shared data services
presentation
processing
data
remote data access, procedure call
remote data access or transaction processing

Software Layers



language and run-time support for program interaction
extended services available to those of the distributed system
applications
Open (distributed) services
conventional and distributed applications
Middleware
Operating system
Platform
Computer and network hardware
responsible for basic local resource management (memory allocation/protection, process creation and scheduling, local interprocess communication and peripheral devices handling)

Software layers

- Service layers
- Higher-level access services at lower layers
- Services can be located on different computers
- Process types:

  -server processes

  - client processes

  - peer processes

Important layers

- Platform

  - lowest-level hardware+software - common programming interface, yet - different implementations of operating system facilities for co-ordination & communication

- Middleware

  - programming support for distributed computing

Middleware provides...

- support for distributed processes/objects:
  - suitable for applications programming
  - communication via
    - remote method invocation (Java RMI), or
    - remote procedure call (Sun RPC)
- services infrastructure for application programs
  - naming, security, transactions, event notification, ...
  - products: CORBA, DCOM

The layered view...

- though appropriate for simple types of resource data sharing:
  - e.g. databases of names/addresses/exam grades
- too restrictive for more complex functions?
  - reliability, security, fault-tolerance, etc, need access to application’s data
  - see end-to-end argument [Saltzer, Reed & Clarke]

Architectural models

- Define

  - software components (processes, objects)
  - ways in which components interact
  - mapping of components onto the underlying network

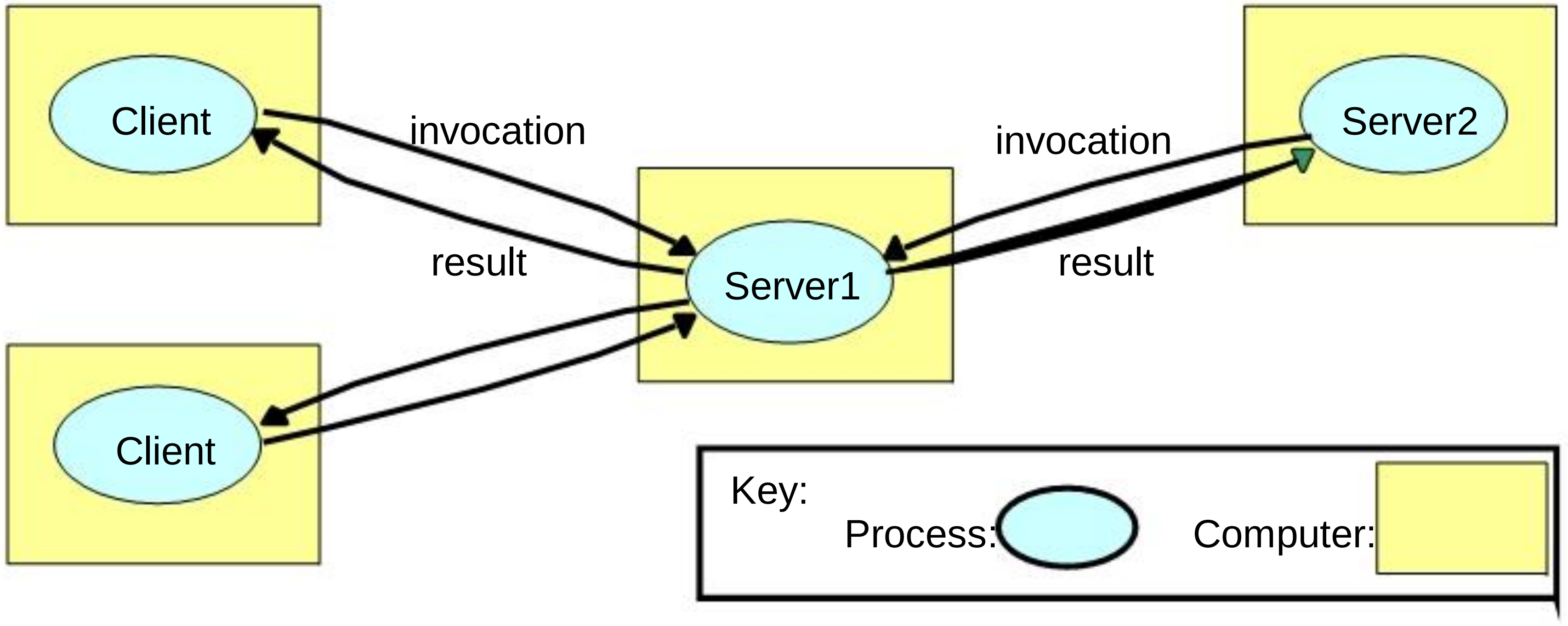
- Why needed?

  - to handle varying environments and usage
  - to guarantee performance

Main types of models

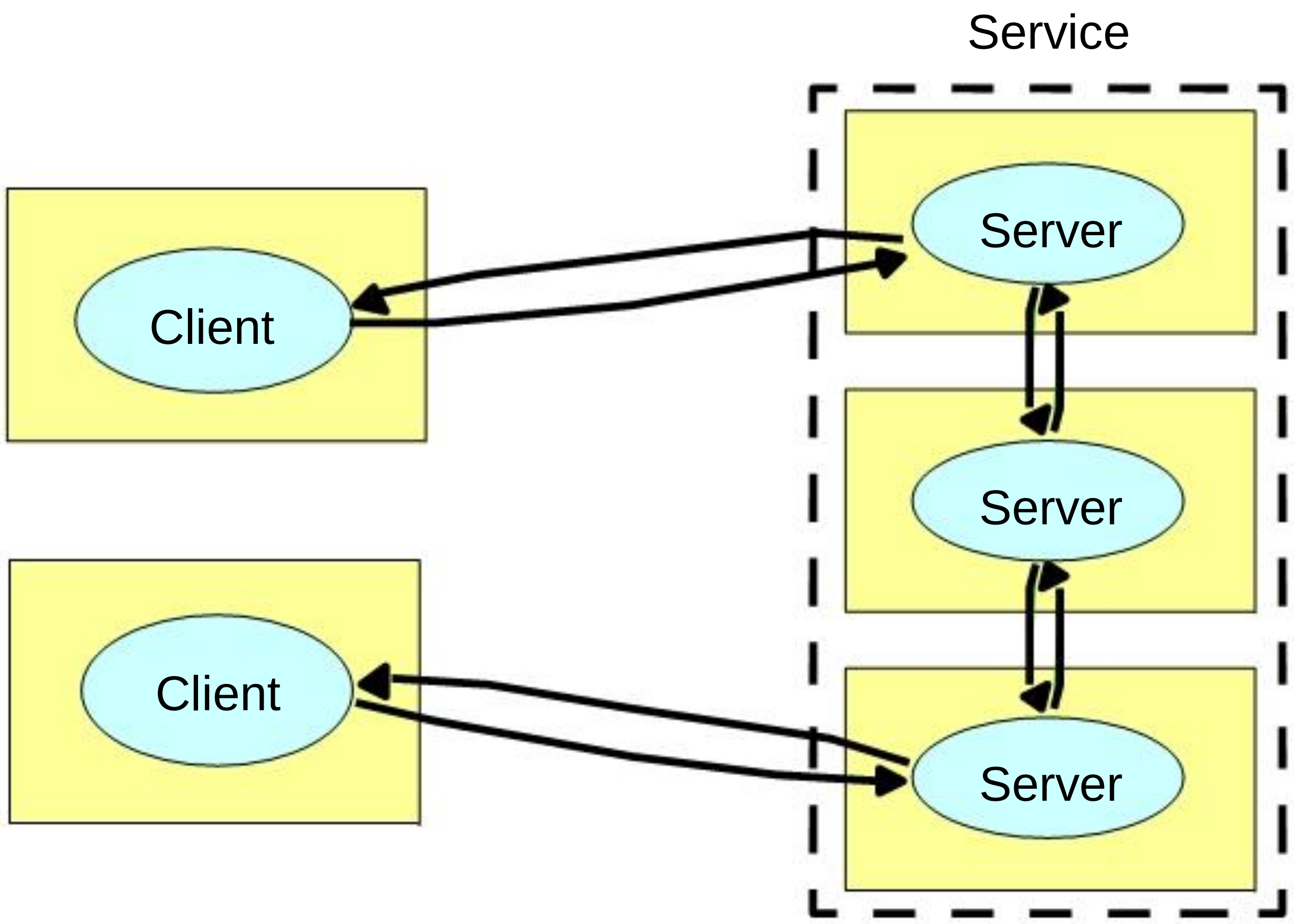
- Client-server
  - first and most commonly used
- Multiple servers
  - to improve performance and reliability
  - e.g. search engines (1000’s of computers)
- Proxy servers
  - to reduce load on network, provide access through firewall
- Peer processes
  - when faster interactive response needed

Client server



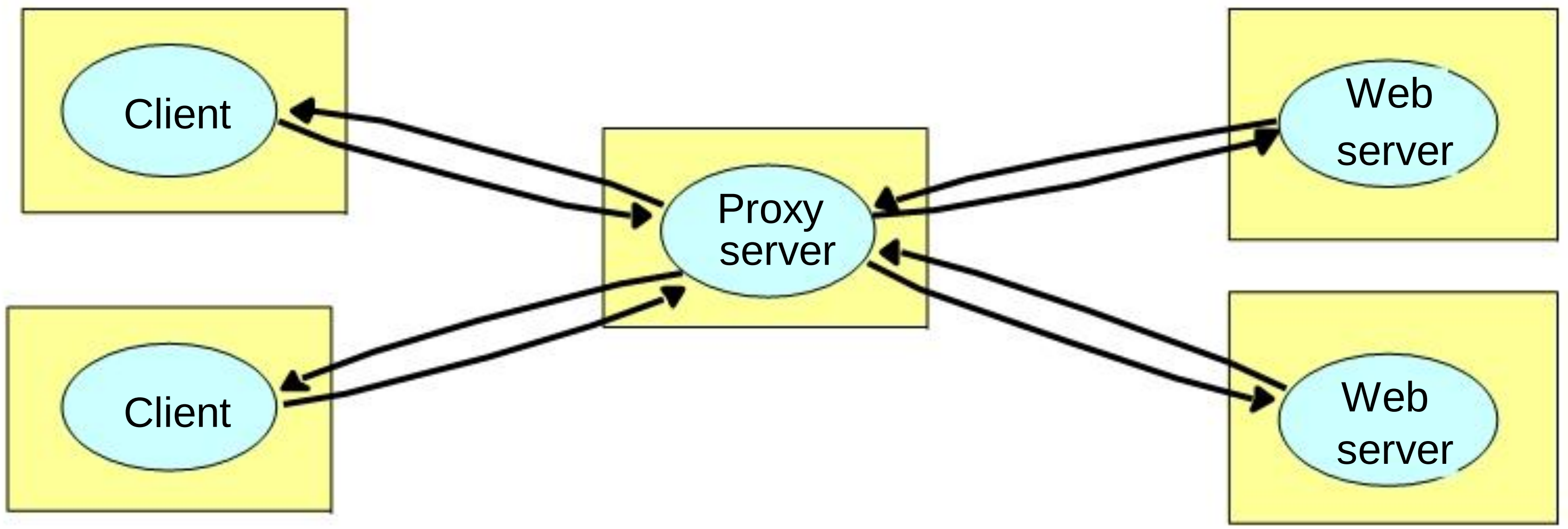
Server1 acts as client for Server2

Multiple servers



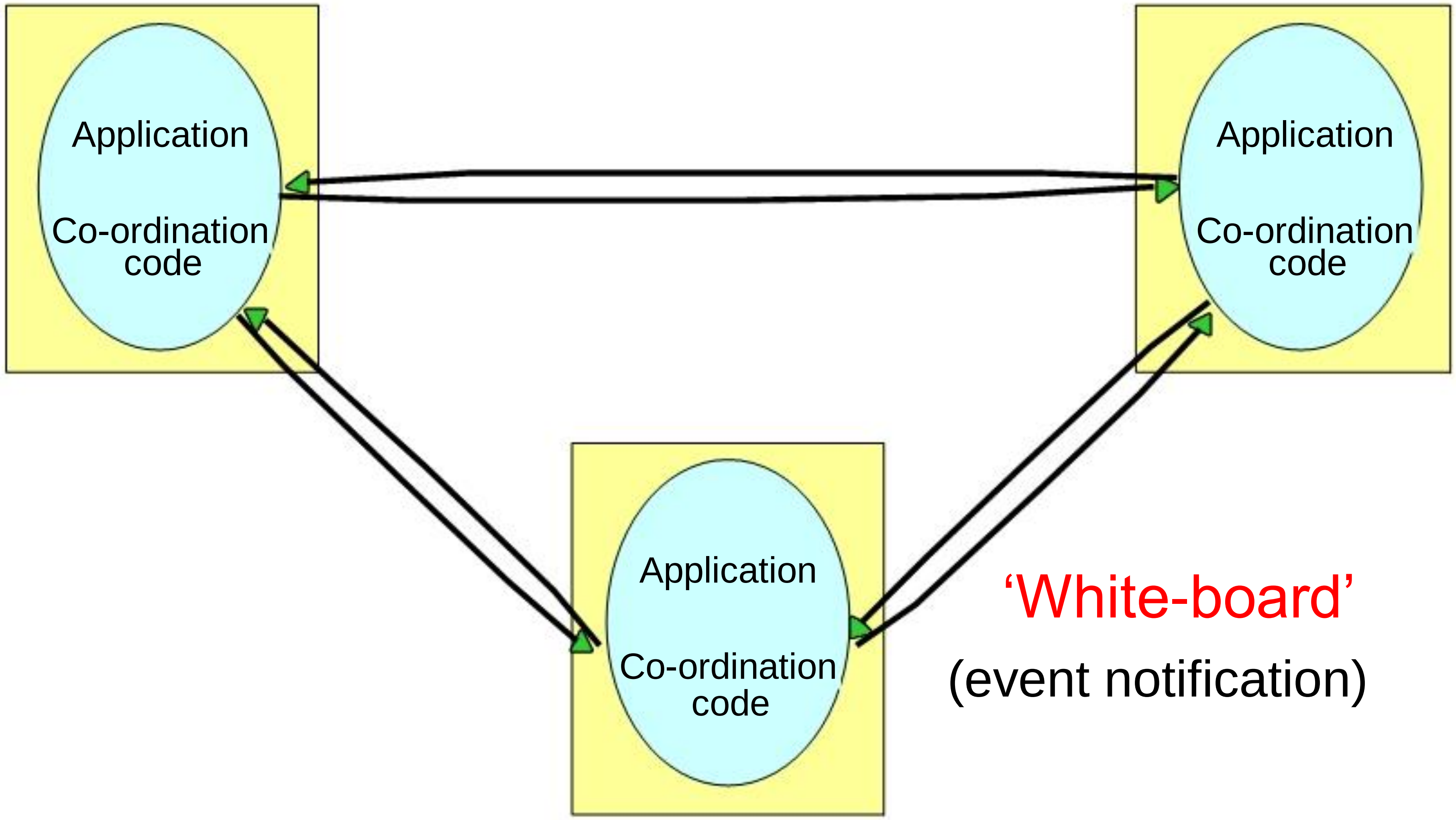
Servers may interact

Proxy servers



intranet firewall outside world

Peer processes



'White-board'

(event notification)

Client server and mobility

- Mobile code

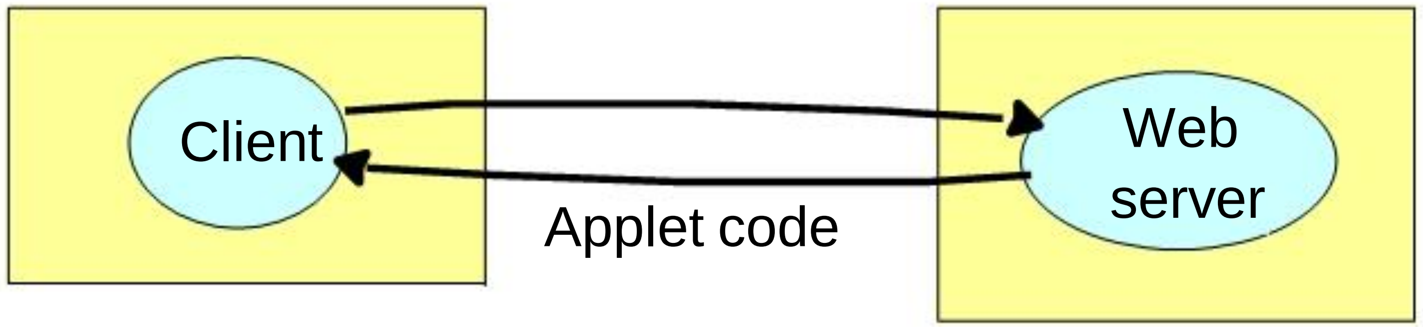
  - downloaded from server, runs on locally
  - e.g. web applets

- Mobile agent (code + data)

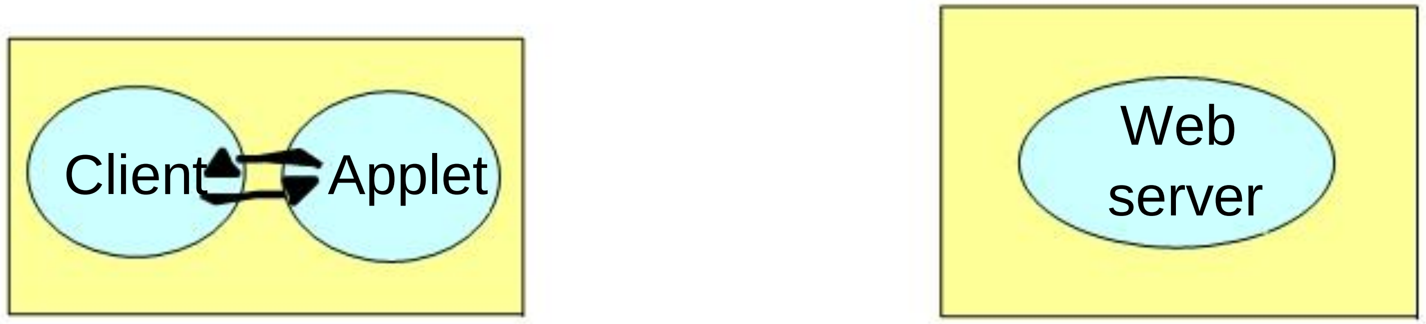
- travels from computer to another - collects information, returning to origin Beware! Security risks

Web applets

Client requests results, applet code is downloaded:



Client interacts with the applet:



Design Requirements for DSs

Judging how good the architecture is...

- Performance
  - how fast will it respond?
- Quality of Service
  - are video frames and sound synchronised?
- Dependability
  - does it work correctly?

Performance

- Responsiveness
  - fast interactive response delayed by remote requests
  - use of caching, replication
- Throughput
  - dependent on speed of server and data transfer
- Load balancing
  - use of applets, multiple servers

Quality of Service (QoS)

Non-functional properties experienced by users:

- Deadline properties

  - hard deadlines (must be met within T time units) - soft deadlines (`there is a 90% chance that the video frame will be delivered within T time units)

    - multimedia traffic, video/sound synchronisation
    - depend on availability of sufficient resources

- Adaptability

  - ability to adapt to changing system configuration

Dependability

- Correctness

  - correct behaviour wrt specification
  - e.g. use of verification

- Fault-tolerance

  - ability to tolerate/recover from faults
  - e.g. use of redundancy

- Security

  - ability to withstand malicious attack
  - e.g. use of encryption, etc

Summary

- Choose between one tier, two tier, …

  - simple versus complex transaction processing

- Client-server architecture most common

  - used for WWW, email, ftp, Internet services, etc

- but can lead to bottlenecks

  - multiple servers for fast response (e.g. Google search engine based on 6,000 Linux PCs)

-proxy servers used to limit load (e.g. through firewall)

- Expected to meet requirements of Performance, QoS and Dependability