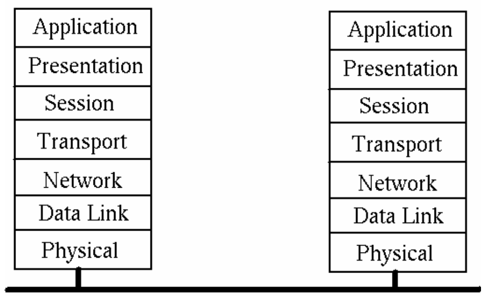
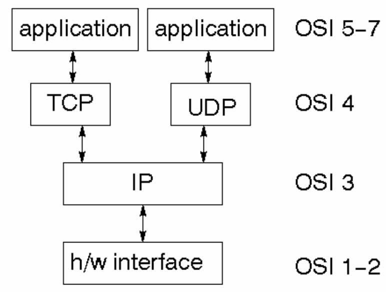
Protocol Layers

- Communications betweens processes takes place using agreed conventions - protocols
- Network communications requires protocols to cover high-level application communication all the way down to wire communication
- Complexity handled by encapsulation in protocol layers

ISO Protocol



TCP/IP Protocol



Some Alternative Protocols

- Bi-directional pipes
- Pseudo-terminals

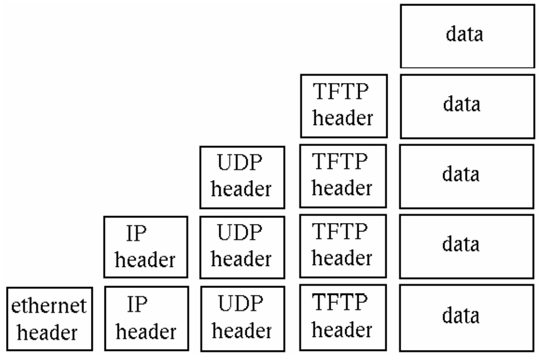
Networking

- A network is a communications system for connecting end systems called hosts
- A local area network (LAN) connects computers that are close together, e.g. by ethernet
- A Wide Area Network (WAN) connects computers in different cities, e.g. by X.15 or ISDN
- A Metropolitan Area Network (MAN) is intermediate in size
- An internet is a connection of two or more distinct LANs or WANs
- An intranet is an internet with all networks belonging to a single organisation

Gateways

- A gateway is a generic term for an entity used to connect two or more networks
- A repeater operates at the physical level copies the information from one subnet to another
- A bridge operates at the data link layer level and copies frames between networks
- A router operates at the network level and not only moves information between networks but also decides on the route

Packet encapsulation

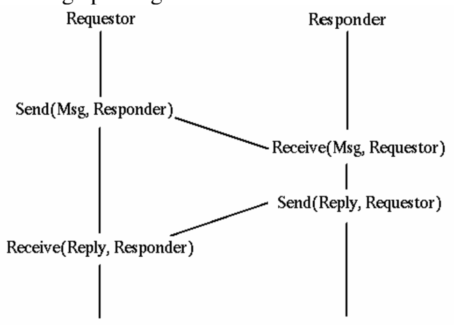


Connection Models

- Connection oriented
- Connectionless

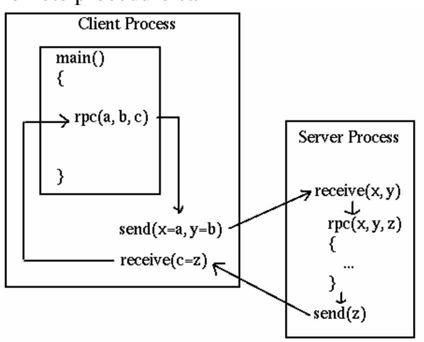
Communications Model

- Message passing



Communications Model (2)

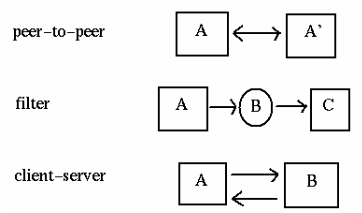
- Event driven
- Procedure call
  - ordinary procedure call
  - dynamic link library procedure call
  - remote procedure call



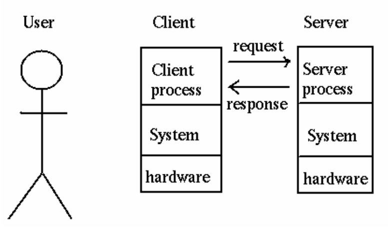
  - lightweight remote procedure call

Client/Server Model

- Peer to peer
- Filter
- Client Server

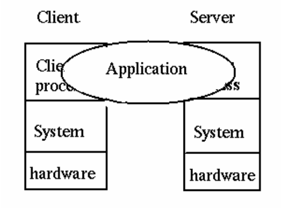


Client/Server System



Slide 12

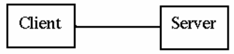
Client/Server Application



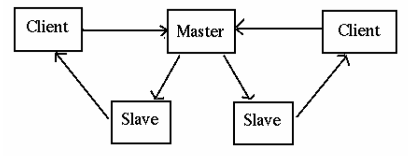
Slide 13

Server Distribution

- Single client, single server



- multiple clients, single server



Slide 14

Server Distribution (2)

- single client, multiple servers

- multiple clients, multiple servers

Slide 15

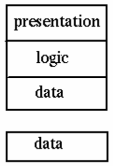
Component Distribution

- Presentation component
- Application logic
- Data access

Examples follow

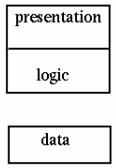
Example: Distributed Database

- Gartner classification: 1



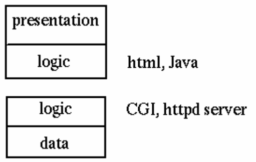
Example: Network File Service

- This allows remote clients acess to a shared file system
- Gartner classification: 2



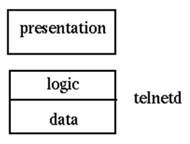
Example: Web

- This is a distributed hypertext system, with many additional mechanisms
- Gartner classification: 3



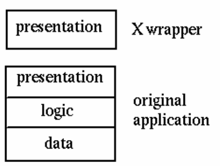
Example: Terminal Emulation

- This allows a remote system to act as a normal terminal on a local system Gartner classification: 4



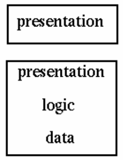
Example: Expect

- This acts as a wrapper around a classical system, either to provide an X Window interface or an alternative character-based one
- Gartner classification: 5

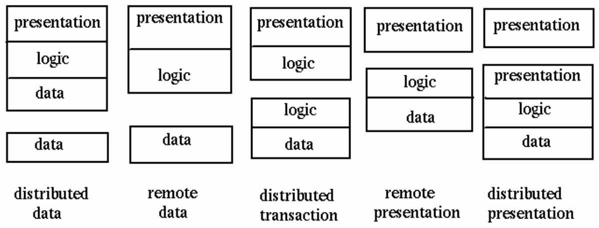


X Window System

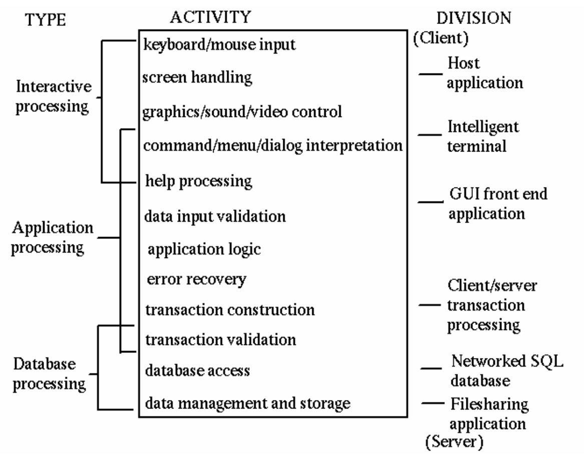
- This decouples application view of windowing and display view of windowing
- Gartner classification: 5



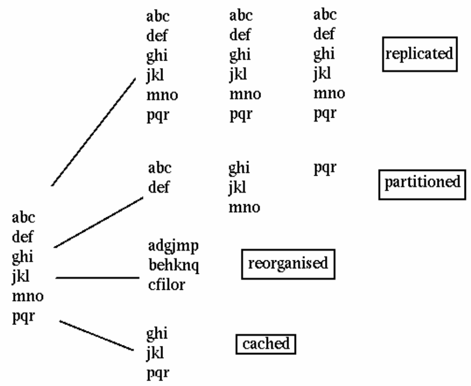
Gartner Classification



Continuum of Processing



Distribution of Data



Points of Failure

- The client side of the application could crash
- The client system may have h/w problems
- The client's network card could fail
- Network contention could cause timeouts
- There may be network address conflicts
- Network elements such as routers could fail
- Transmission errors may lose messages
- The client and server versions may be incompatable
- The server's network card could fail
- The server system may have h/w problems
- The server s/w may crash
- The server's database may become corrupted

Acceptance Factors

- Reliability
- Performance
- Responsiveness
- Scalability
- Capacity

References

- P. E. Renaud *Introduction to Client/Server Systems* Wiley, 1993, ISBN 0-471-57774-X
- Don Libes, *Expect* O'Reilly Press
