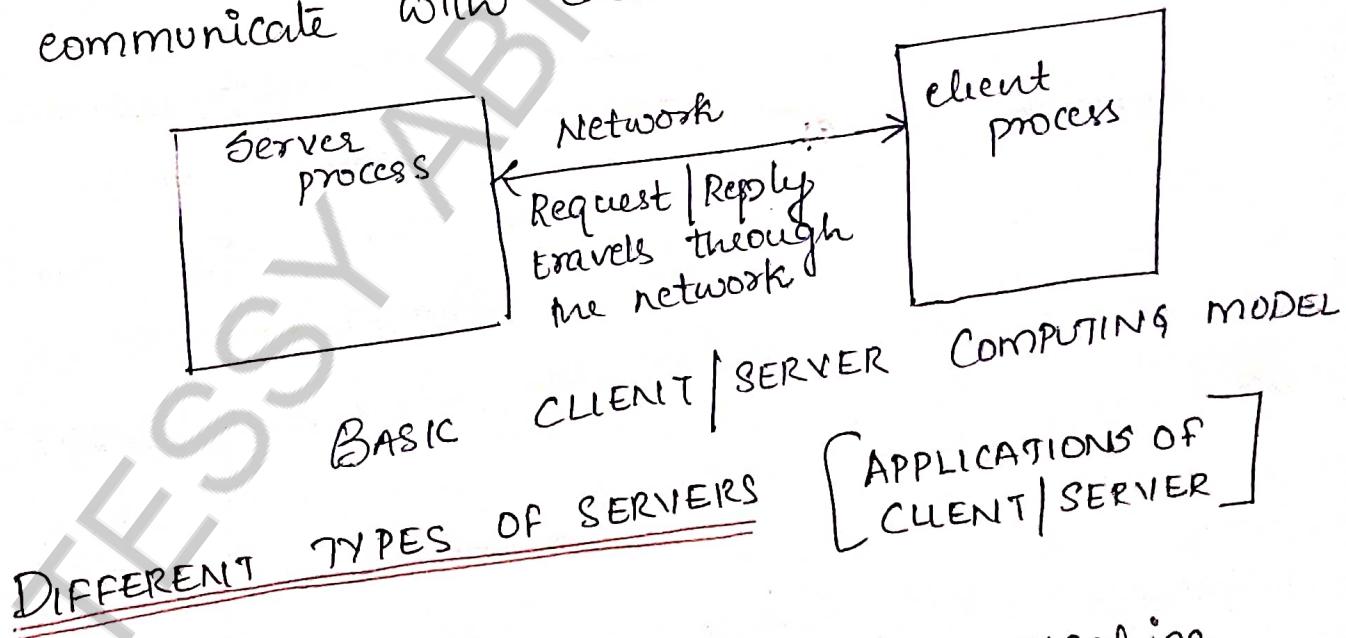


## Introduction

Client: Any process that request specific services from the server process.

Server: A process that provides requested services for the client.

- client and server process can reside in same computer or in different computers linked by a n/w.
- If client and server processes resides on 2 or more independent computers, Server can provide services for more than one client.
  - Client can also request services from several servers on the network.
  - The network helps the client and server to communicate with each other.



### ① FILE SERVER

→ All the files reside on the server machine

→ File server provides clients access to records within files from the server machine.

One example of file servers are:

a) UNIX: Network File Services (NFS) created by Sun MICRO systems.

b) Samba: An open source/free software that provides files and also print services.

② PRINT SERVER

- This machine manages user access to printer
- Print services can run on a file server, or on a separate print server machine.

③ APPLICATION SERVER

- This machine manages access to centralized application software eg shared database.
- When user request information from the db, the application server processes the request and returns the result of the process to the user.

④ MAIL SERVER

- This machine manages the flow of electronic mail, messaging and communication with mainframe systems on large scale network.

⑤ FAX SERVER

- Provides facility to send and receive the faxes through a single network connection.

⑥ DIRECTORY SERVICES SERVER

- When the data is distributed throughout multiple servers, this machine keeps track of what is stored where.
- This machine functions as organization manager.

⑦ WEB SERVER

- This machine stores and retrieves Internet (or intranet) data
- Then clients use a web browser to request those documents.

- The most commonly used protocol is HTTP (HyperText Transfer Protocol)

→ examples 1) Microsoft's Internet Information Server (IIS)  
2) Oracle Application Server.

## ⑧ Database SERVER

→ Database server provides access to data to the clients, in response to SQL requests.

→ The database server receives SQL requests and processes them and returns only the requested data by: oracle db database server.

## ⑨ TRANSACTION SERVER

→ Data and remote procedures reside on the server

→ It is often used to implement OLTP (Online Transaction Processing)

→ Transaction server receives high level function request from the clients and it implements that function.

## ⑩ GROUPWARE SERVERS

→ It provides services which put people in contact with other people.

→ eg Lotus Notes

## ⑪ OBJECT APPLICATION SERVERS

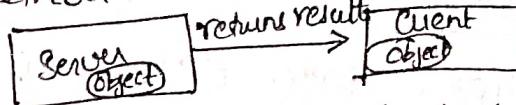
→ These servers are responsible for sharing distributed object across the network. Each distributed object can have one or more remote methods.

→ Protocols

→ The protocol used here is ORB (Object Request Broker)

→ ORB locates the object server class,

invokes the requested method and returns results to the client object.



eg: Common Object Request Broker Architecture (CORBA)

: Iodus Orbix

Client / Server : Fat or Thin

• Fat client / <sup>Thin</sup> server / Thick client

- can run independent of server
- Processing is done more on the client machine.
- have backup datas so can run offline.

• thin client / Fat server

- needs server to run.
- have to be connected online.
- Processing is done more on the server

machine.

Advantage

change needed, only  
needs to be changed.

Easier to manage, if any  
the software of the servers

Client / Server : Stateless or Stateful

Stateless server: Is a server that treats each request as an independent transaction that is unrelated to any previous request. Here client specifies complete file names in each request and also re-authenticate each request.

Adv.:

- (i) No need to dynamically allocate storage
- (ii) More informations are added in each request

Disad: (i) More informations will need to be interpreted

and this extra information each time.

by the server each time.

(ii) Stateless server is more robust.

eg: World Wide Web Server.

(of stateless server)

## Stateful server

- Client data (state) information are maintained by server
- Server remembers what client requested previous and maintains the information as an incremental reply for each request

Adv : (i) Client can send less data with each request. So request size is small.  
(ii) Stateful server is simpler.

## Disad:

- (i) If clients crash (or reboot) frequently state information may exhaust server's memory.

e.g. of stateful server → remote file server.

## Servers AND MAINFRAMES

- Mainframes are multiusers, high performance computers having high speed and large storage capacity.
- Servers can behave like mainframe if their processing power is increased.
- Client / Server networks often find it necessary to connect to main-frame based systems.

How do client / server systems differ from mainframe systems?

## Mainframe Systems

- In mainframe systems, all the processing takes place on the mainframe and 'dumb' terminals display the data on the

screen. But in client/server environment provides a clear separation of server and client processes.

→ The relationship between terminals and mainframe is one to one but relationship between client and server is many to many.

→ Application development: Mainframe systems are over structured, time consuming and create application backlog.

Client/Server systems are flexible, have rapid application development and better productivity tools.

→ Data manipulation: Mainframes have very limited data manipulation capabilities.

→ System management: Mainframes are integrated systems but for client/server systems only few tools are available for system management.

→ Security: Mainframe systems are highly centralized.

→ End user platform: Client/server systems are intelligent dumb terminals. Client/server systems are intelligent PCs with graphical user interface having multitasking OS.

## CLIENT / SERVER FUNCTIONS.

The main operations of client system

• Managing the user interface

• Accepts and checks the syntax of user inputs.

• Generates database request and transmit to

server.

• Passes response back to server.

• Processes application logic.

## The main operations of Server

- Accepts and processes database requests from clients.
- Checks authorization.
- Ensures that integrity constraints are not violated.
- Performs query / update processing and transmits response to client.
- Provide concurrent database access.
- Provides recovery control.

## CLIENTS / SERVER - ADVANTAGES AND DISADVANTAGES

### Advantages:

- (i) Performance and reduce workload  
Processing is distributed among the client and server. This reduces the load on the network that connects the workstation.  
eg: If the server is a database server, and the network traffic is reduced to queries to and responses from the database server. [Database files which are large in size is not passed on the net].

- (ii) Workstation independence:  
→ Users are not limited to one type of system or platform.

- eg: → On an Oracle based client / server system  
workstations can be IBM-compatible PC's,

Macintoshes, UNIX workstations or any combinations of the three.

→ They can run any number of operating systems such as MS-DOS, Windows, IBM's OS/2 etc.

(iii) System interoperability: makes it possible for client/server computing systems [client & server] different types of component systems to work together.

(iv) Scalability: changes in client/server system can be done without adversely affecting the rest of the systems. eg: It is possible to upgrade the server to a more powerful machine with no visible changes to the end user.

(v) Data Integrity: client/server system preserves data integrity.

- client server provides
  - \* encrypted file storage
  - \* realtime backup (while db is being accessed)
  - \* disk mirroring (data is automatically written to duplicate db on another partition of same hard disk drive)
  - \* disk duplexing (data is automatically written to a duplicate db on a different hard disk drive)
- \* transactions processing (DBMS keeps a running log of modifications made to the database over a period of time)

(vi) Data accessibility: enhanced - data sharing

- Server holds the data in a centralized location so multiple users can access and

work on the data simultaneously.

### (vii) System administration (centralized management)

→ All activities are controlled by central in the server.

→ So client / server environment is manageable.

### (viii) Integrated Services

→ In client / server model all information that the client is entitled to use is available at the desktop, there is no need to change into a terminal mode or to logon into another processor to access information.

processor to access information among diverse platforms

### (ix) Sharing resources

→ Applications can be created and implemented without much conversance with hardware and software.

→ users can obtain clear services and transparent access to the services provided by the servers.

by the servers.

### (x) Masked physical data access

→ SQL is used for data access from db stored anywhere in the network from local PC,

local server or WAN server.

→ Data may be accessed with same SQL statements from CD-ROM, HDD, Magnetic disk

etc.

→ Logical tables can be accessed without any knowledge of the ordering of columns.

(xi) location independence of data processing  
→ user log into an application from the desktop with no concern for the location or technology of the processor involved.

Ex: → Data is accessed through SQL without regard to the hardware or OS location providing the data.

(xii) Reduced operational cost  
→ Client / Server computing replaces expensive large systems with less expensive smaller ones networked together.

(xiii) Reduced hardware cost  
→ Only server requires storage and processing power sufficient to store and manage the application. Application costs are reduced.

(xiv) Communication costs are done on the client  
→ Part of the operations are done on the client and send only request across the network to the server resulting in less data being sent across the network.

### Disadvantages

Maintenance cost :-  
(i) Maintenance  
→ There is an increased cost of administration and support personnels to maintain the server and database. When the number of database server users rises, or if the database grows in size, a database administrator is hired to run the DBMS and support the front ends.

## (ii) Training cost

→ Training should be given to the support personnel if the system servers runs on an operating system he is unfamiliar with.

## (iii) Hardware cost

→ Servers need high-powered platform with a large amount of RAM and hard disk space.

## (iv) Software cost:

→ Overall cost of software is higher.

## (v) Complexity:

→ In client/server computing, the more are the pieces, which compromise the system the more things can go wrong or fail. So it takes time to get everything set up and start working.

## SINGLE SYSTEM IMAGE (SSI)

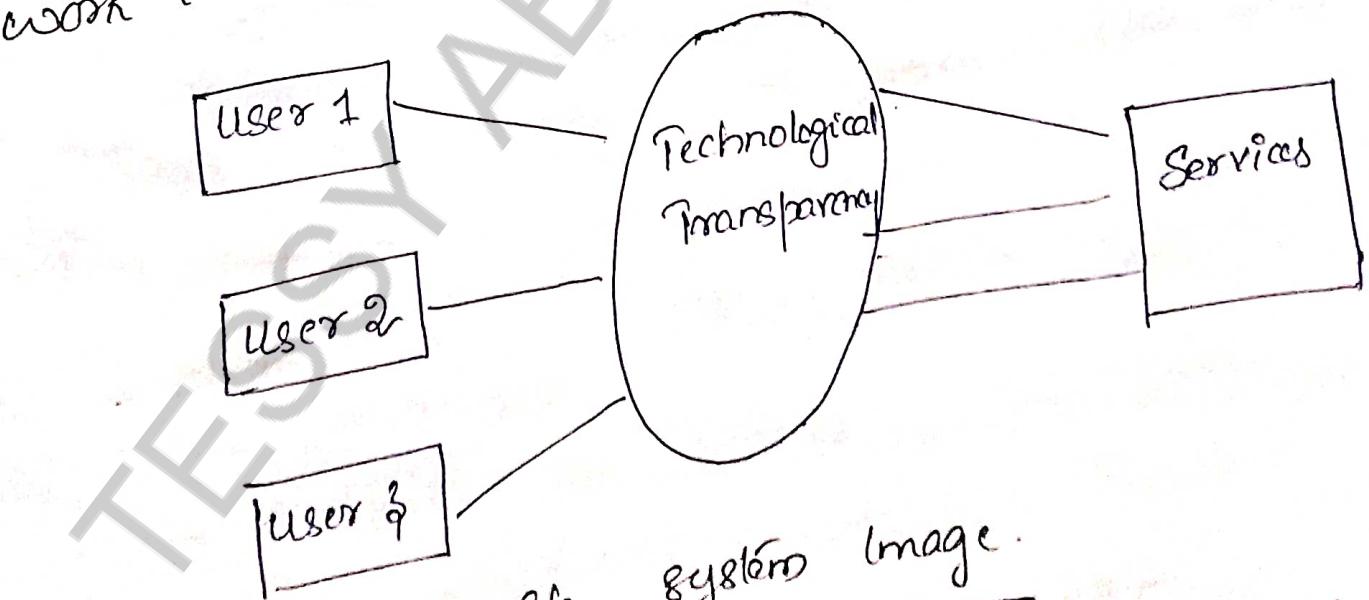
→ A single system image is the illusion, created by the software or hardware, that presents a collection of resources as one, more powerful resources.

→ SSI makes the systems appear like a single machine to the user, to applications and to the network.

→ Client/Server Systems has an environment which is heterogeneous. A business system user is totally unaware of where the data is stored, how the client and server processors work and what networking is involved in gaining connection.

→ This transparency is accomplished by:

- \* Every application that the user access provides a common "look and feel".
- \* Access is provided through a standard security procedure for every application.
- \* The security layer is invisible to the unauthorized and impenetrable to the authorized.
- \* New applications can be added with minimal work in the same way.



Advantages of single system image.

- Increase the utilization of system resources transparently.
- Provides improved reliability and higher availability.

- Provides overall improved system response time and performance.
- Reduces the risk covered due to operator errors.
- User need not be aware of the underlying system management.
- Gives simplified system management.

Drawing Forces behind Client / Server

Forces that drive the move to client/server computing  
widely are categorized based on  
(i) Business perspective (ii) Technology perspective.

### BUSINESS PERSPECTIVE

(i) Business Process Reengineering:

→ Competitiveness → forcing organizations to find new ways to manage their business, despite fewer personnel, more outsourcing, a market driven orientation and rapid product obsolescence.

(b) Globalization - The world as a market

→ Information technology plays an important role in bringing all the trade on a single platform by eliminating barriers

→ IT helps and supports various marketing priorities like quality, cost, product differentiation and services

(c) Operational Systems - Competition for Investment

Dollars → companies are questioning the return on

their existing investment.

(d) Market Driven - flexible to meet needs

→ Product obsolescence has never been so vital a factor

→ Buyers have more options and are more demanding

mainframes did only a few years ago.

→ this power and capacity is used to create solutions to real business problems.

### (e) Growing importance of workgroup computing

→ Workgroup have access to information and work collectively.

→ Decisions are made in the workplace, not in the head office.

### (f) Network Access

→ Workstation uses to access information and systems without regard to location. Remote network management enables experts to provide support and reliability to distributed system.

### (g) Multivendor Environment

→ Standard based technology is needed for the heterogeneous multiple vendor environment.

### CLIENT / SERVER

### DEVELOPMENT TOOLS

Client / Server tools include:

Client / Server development

\* GUI Based development

\* A GUI builder that supports multiple interfaces

{ Windows, OS/2, Motif, Macintosh and so on}

\* Support for third party development tools

{ CASE, libraries and so on}

\* Support for middle ware protocols

{ ODBC, IDAPI and so on}

- \* Support for multiple n/w protocol [TCP/IP, XXP/SPX and so on].
- \* Support and seamless access to multiple database [hierarchical, networked, relational].
- \* Support for multiple platforms (OS, Hardware and GUI's)
- \* Support for multiple data models using SQL [relational datamodel, entity relationship data model and so on].
- \* Object oriented development with a central repository for data and applications.
- \* Team development support.
- \* Complete SDLC (System Development Life Cycle) support from planning to implementation and maintenance.

#### DEVELOPMENT PHASES

→ A marketing plan is developed before actually starting the design and development. The objective of the plan is to build and obtain the end-user and manage the client/server environment.

There are 6 main phases in client/server system development:

(i) Information Systems Infrastructure selfstudy

→ This determines the state of the available computer resource.

resource.

→ The self-study generates

- ✓ A software and hardware inventory.
- ✓ List of critical applications
- ✓ Detailed human resource (personal and skills)
- ✓ List of problems and opportunities.

(ii) Client | Server Infrastructure Definition

→ Here the output  
company's infrastructure goal.  
↳ opportunity.

(iii) Selecting a window of opportunity for an appropriate environment

- choose an approach to base the infrastructure.
- Here a right system is found to base the client server pilot project.

(iv) Management Commitment  
→ Plan the activities  
Focus necessary resources (people, money, software) will be available.

→ Infrastructure, hardware, dedicated to the system  
available and a person is designated to work as a

## guide

## (v) Implementation

Implementation  
→ After satisfying all the requirements implement it.

## To implement

- ✓ Use standard-based or open tools
- ✓ Continuous training in hardware, software tools and development principles. By vendors & consultants.

## (ii) Review and Evaluation

- Error correction is done.
- Continuously measure system performance as the system load increases. Sometimes as the load increases, network traffic increases and slows down the network.

## CLIENT - SERVER SECURITY

- A security threat is defined as circumstance, condition or event with the potential to cause economic hardship to data or network resource in the form of destruction.
- Client / server security problems include
  - \* Physical security holes :- This results when any individual gains unauthorized access to a computer by getting some user's password.
  - \* Software security holes :- This results due to some bug in the software, due to which system gives wrong performance.
  - \* Inconsistent usage holes :- This results when two different usages of a system contradict over a security point.

→ Software security holes and inconsistent usage  
holes can be eliminated by careful design and  
implementation.

→ Physical security holes can be corrected using the  
following security methods

- \* Trust based security.
- \* Security through Obscurity.
- \* Password Scheme
- \* Biometric System.

### Emerging Client | Server Security Threats

Threats to client | server security are  
environment from mobile

(i) Threats to local computing  
code : threats to servers include impersonation,  
(ii) Threats to servers , denial of service , packet reply and  
eavesdropping , denial of service , packet reply and  
packet modification .

Threats to local computing environment from mobile  
code

→ Software agents or mobile code are executable program  
programs that have ability to move from machine  
to machine and also can invoke itself without  
external influence.

→ Client threats arise from malicious code or data  
like viruses , worms .

Virus → a code segment that replicates  
copies of itself to existing  
executables . The new copy of the virus is  
executed when a user executes the host programs

Worms are a self replicating programs that is self contained and does not require a host program. The program creates a copy of itself and utilises network services to propagate to other host systems eg Trojan Horse, logic bomb.

### → Protection method

Scan for malicious data and programs fragments that are transferred between server and client and filter it out.

### Threats to server:

(i) Eavesdropping → An activity of silently listening to the data sent over the network. Hacker can make a complete transcript of the network activity and obtain sensitive information such as password, data and procedures. Soln → encryption.

(ii) Denial of service → A situation where a user renders the system unusable for legitimate users by hogging or damaging a resource. Service overloading → A large amount of illegitimate service request is sent to the server to consume up its CPU cycle resource.

Message flooding → process of increasing the number of receiving processes overwhelming of the server by sending large files repeatedly after short interval of time causing disk crash.

(iii). Packet replay → Recording and retransmission of message packets in the network.

A hacker gains access to a secure system by recording and replaying a legitimate authentication sequence message. It can distort the original message.

Solution:- Packet time stamping and sequence counting.

### ORGANIZATIONAL EXPECTATIONS

- Managers look for client / server benefits.
- Flexibility and adaptability.
- Improved employee productivity.
- Improved company workflow and a way to reengineer business operations.
- New opportunities to provide competitive advantages.
- Increased customer satisfaction.
- Flexibility and adaptability and efficiency in changing business conditions, client / server computing should be flexible.
- To adapt quickly and efficiently in market conditions, a company that can adapt quickly to changes in its market cannot.
- A company that can adapt quickly to changes in its market conditions is more likely to survive than one that cannot.
- Improved Employee Productivity
- Quick and reliable information access enables end users to make intelligent decisions.
- So end users are more likely to perform

their jobs better, provide better services and become more productive within the corporation.

### Improved Company Workflow and a way to reengineer Business Operations

→ Providing the right data to the right people at the right time

e.g.: Lotus Notes

↳ These workgroup tools are used to route the forms and data to the appropriate end users and co-ordinate employee work.

### New Opportunities to provide competitive Advantages.

→ Organizations enhance their ability to compete by increasing market share through the provision of unique products or services.

→ here a proper information management is needed.

### Customer Service Satisfaction.

#### Increased

→ New and better services are provided, so customer satisfaction is improved.

→ Client / Server systems enable the corporate MIS managers to locate data closer to the source of data demand.

## Downsizing and Right sizing

→ Right sizing and downsizing are strategies used with the client/server model to take advantage of the lower cost of workstation technology.

### Downsizing

↳ It is an attempt to use cheaper workstation technologies to replace existing mainframes and mini-computers.

Adv:

- (i) clients having power at the cost of less money.
- (ii) Better performance.
- (iii) System offers flexibility.
- (iv) An increase in overall benefits.

### Right sizing

↳ It is an attempt to move the client/server platform to the most appropriate server platform applications to the most appropriate functionality, performance and increased functionality, performance and flexibility of applications.

Adv:

- (i) Increased flexibility of applications.
- (ii) Significant cost savings as employees are reduced, maintenance becomes less.

### Upgrading

↳ One bottom-up trend of networking LAN were implemented in early days on hardware (like printer, scanner) only to share data and applications. but now it is used to share data and applications.

## Ways to Improve Performance

To increase the performance of client / server, the following can be done.

(i) Offload work to server

(ii) Reduce total execution time.

(iii) Use a multitasking client.

Offload work to server:

→ Here the server has greater processing power than the client workstation.

→ Database, communication processing, other complex processes are offloaded to a fast server processor.

→ By increasing the processing power of the server, the client workstation is available to handle other client tasks.

Reduce total execution time

Several servers can be used together,

each performing a specific function.

→ Servers may be multiprocessors with shared memory.

→ So increased power of the server enables it to perform its function faster than the client workstation.

→ High speed local area network topologies providing high speed communications are also introduced.

The time to transmit

the request to the server, execute the request, and transmit the result to the requestor, must be less than the time to perform the entire transaction on the client workstation.

### Use a multitasking client

→ Multiple processes should be running on the client workstation.

→ Several of the applications can be dynamically linked together to provide the desktop information processing environment.

e.g.: functions like DDE (Dynamic Data Exchange) and Object linking and Embedding (OLE) permits to include spreadsheet documents processed dynamically into word

