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# THE CLIENT / SERVER COMPUTING ENVIRONMENT AN OVERVIEW

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## Abstract

The development of a client/server system involves defining client/ server architecture and then integrating this architecture with other system architectures and technologies that are vital to client/server implementation.

In this paper, we will review the elements of the client/server: resources-sharing architecture, distributed database processing, relational database, network connectivity, and network management issues. In addition, the role of structured Query language (SQL) as an essential link in client/server computing is summarized. The paper will also present an overview of the open system inter connection (OSI) standards for network development.

**Keywords: Client / Server computing environment.**

## Introduction

## 1. Client/Server Architecture

The architecture of a client/server system is distigished by the incorporation of intelligent user workstations as active platforms and the interoperability between pate forms and software. The client server architecture involves multiple computers connected in a network. The computers that process applications and request services from another computer are called clients. The computer designed to process the database is called the server. All users have their own computers to process applications. The client computers can be main frames, microcomputers or minicomputers. Because of the cost advantages, however, microcomputers are generally selected to act as clients. In a data base environment, the clients may communicate with the server by means of programming interfaces called middleware. These interfaces provide connectivity between application and databases.

### The Clinet

The client runs the programs that enable the user to formulate requests for services and passes the request to the server. Computing done by the client is called front-end processing. The front-end processor handles all functions related to presenting, manipulating, and displaying data.

The client software consists of the network interface software, the application programs supporting the user requirements, and utilities, which utilize the network capabilities [e.g., electronic mail, Groupware].

### The Server

Computing performed at the server is called back-end processing. The back-end hardware is a computer that messages the data resources and performs the database engine functions such as sorting, manipulating, and protecting data. In a mainframe environment, a back-end network provides the connections of mainframe computers to mass storage

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devices, controllers and file servers. The identification, evaluation, and selection the appropriate server platform must take into consideration that services to be provided by the server. fOr example, a data base server may require a fast processing capability, rapid disc access, and possibly fault tolerance to ensure satisfactory network performance. Other network services that may need to be addressed are requirements of communications; applications, file access, and compact disk Read Only Memory services. The list of protocol services, which may be provided, will continue to grow, as new applications of technology become commonly available. Server software includes both the network software complaint with the OSI or other network architecture and the applications or service software provided by the server to the clients on the network.

**Middle ware**

Middle ware is layer of software that shields applications developers from different communications protocols, operating systems, and databases management systems. It provides the foundation for new applications. There are several types of middleware. They include application programming interface (APIs), remote procedures calls (RPCs), network management, database access, and computer aided software engineering (CASE) tools.

Since a client server system requires the integration of various architectural components and technologies, application programmers to write code for each visual protocol and operating system.

## 2. Resources Sharing Architecture

The architecture of a resources-sharing system differs from the architecture of a client/server system in that the data bases management system (DBMS) is on the local computers. Thus, the special considerations must be given integrating these two architectural concepts. In resources sharing, the DBMS on each user's computer must send request to the operating system on the file server. In a client / server system, the request would simply be produced using the appropriate SQL command. Since the DBMS in the resources sharing architecture is on the local computer, the software needed to process SQL or any similar language is not available on the file server. Therefore, to access the data on another computer, the entire file (and possibility the associated index files) must be passed through the server.

The negative aspect of the resources sharing architecture is that a large portion of the database must be locked while a user request is being processed. This reduces throughput, rendering the architecture incompatible with transaction processing. On the positive side, designating a server that downloads large sections of data that does not have to be updated or returned to the database can facilitate the quarry processing of down load data. This approach to resource sharing from download data is effective for performing query and reporting functions. The use of resource sharing for processing down load data with a main frame as a file server as shown in figure 1.

## 3. Distributed Database Architecture

Distributed database processing involves the execution of transactions and the updating of data across two or more geometrically separated computer.

The hard ware nodes in a distributed data base system may be homogenous our heterogeneous. The software required includes the distributed data base management system (DDBMS), which consist of the collection of distributed

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transaction and data base manager that reside at each node; a distributed transaction manager that receives processing requests from query or transaction programs and translates them into the action command.

Data in a distributed database system may be no replicated, partially replicated, or fully replicated. No replicated data means that only one copy of each data item exits. These data items reside only at their assigned node. Access to these data must be obtained from that node.

Several types of procedures must be considered in distributed data base processing. Procedures that grant processing rights define that which nodes have access to the data. Procedures that concern currency are necessary to avoid processing of outdated data. Control procedures are needed to resolve problems that may rise from conflicting processing requests. Figure. 2 illustrate a typical distributed databases system.

## 4. Relational Data Base Architecture

A relational database is defined as databases in which the individual files termed relations, hold data in the form of flat files or tables. The table must contain only one type of record. Each record has a fixed table must contain only one type record. Each record has a fixed number of fields, all which are explicitly named. The fields within a table are distinct, and repeating group is not allowed. There are no duplicate records and no predetermined sequence of records.

In the construction of relational databases, it is necessary to give careful consideration to the contents of relations and inherent relationship between attributes (fields) of a record.

The fundamental operations on a relational database are selection, projection, join, and division. Selection produces a new table containing the same number of columns as the original relations, but the row will contain those of the original relation that satisfy some specified criteria. The projection operation specifies columns to be selected. The resulting table thus contains only a subset of the columns of the original table. If two rows differ in the columns deleted by the projection, only one record will be carried forward to the new relation. The join in the two tables is used as the basis of the combination of records. Records with equal values in the common field are concatenated in the resulting relation.

## 5. Objected – Oriented Database Management Systems

Relational database technology is based on a well-articulated mathematical model of uniform data structure and relatively simple relationships. The complex data structure associated with information system, however, may include such diverse components as text, graphics, voice, and video. These data are not uniformly structured, making their incorporation into traditional relational DBMSs difficult. Object-oriented databases have been introduced to solve such functions as document management, workflow management, and Group Ware processes

Numerous venders have object-oriented database management systems (OODBMSs) on the market.

### Hybrid Systems

Hybrid database systems place an object-oriented front end on top of a relational database kernel. The front end decomposes the application objects and stores them in a relational table. When needed, the objects are then recomposed

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and presented to the user. This approach is effective form the object-oriented development point of view, but does impose performance overhead. A typical hybrid system is Hewlett Packard's open ODB.

### Extended Relational System

Numerous vendors are making extensions to the relational model. These extensions include storage of complex data types in relational tables, stored procedures, triggers, and binary large objects (BLOBs). The extensions of SQL now being considered in the SQL3 standards will include further support for objects. These will likely include supports of user defined data types and nested tables. Vendors providing objects extensions to the relational, model include Sybase, Informix Oracle, and Borland.

### *SQL*

SQL provides an essential link in the client server architecture. SQL has been endorsed as the recognized industry standard for manipulating databases by the American Standards Institute (ANSI). It is the data assess language used by database management system (DBMS) products.

SQL allows user to run queries irrational table data, create new tables, access existing remote tables, manipulate data, create application to access SQL data, run SQL statements, handle errors, and access multiple servers. The SQL database servers are multiuse relational database management systems (RDBMSs)
SQL commands can be used interactively as a query language or embedded in application programs. In performing g a query, SQL accepts one or more relations as input and produces a single relation as out put the result is a table or flat file (i.e., a collection of records of the same type which do not contain repeating groups). In querying multiple tables, the tables are joined by SQL. Provisions are included in SQL for inserting new data into a table deleting data from a table, fro modifying table data.

### 6. Server Data Management Facilities

Server data management encompasses facilities that enable data to be accessed from any node in the network to ensure privacy, recovery, and integrity in multi-user environment. The essential access link in client server computing is SQL, a high – level non-procedural database language. Numerous back-end servers and DBMSs have been developed that support SQL. These include the products described below.

### *DB2*

DB2 is RDBS developed by IBM. It uses SQL to perform all data base operations: data access, data manipulation, authorization functions. SQL statements are entered by a user client node or embedded in applications.
DB2 constructs in clued tables, views, table spaces, indexes, index space, databases, and storage groups. The RDBNS provides facilities that allow user to dynamically create and modify these constructs.

DB2 place on exclusive lock on the data to prevent other applications from accessing the data. DB2 also offers options regarding the level or lock size.

All data base changes are stored and checked periodically b DB2. all changes residing in system buffers are written to the databases, and change recent changes written to the log. DB2 includes utility programs for re-creating the database from backup copies. This utility includes an option that allows user to make backup copies of only those pages in a table space

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that have been modified since the last backup was performed. DB2 also includes security provisions to protect the database.

## 7. Borland Object Component Architecture (BOCA)

Borland object component architecture establishes a client/server foundation that takes into consideration both development tools and database management tools, middleware, and database server technologies to provide client/server solutions. The components of the architecture are:

Advance object-oriented tools that take full advantage of the client/ server revolution. Borland C++. Turbo Pascal, Paradox, dbase, Quattro Pro, and object vision are all built using object-oriented methodologies.

Integrated database application programming interface (IDAPI) is Borland's connectivity solution. IDAPI enables developers to create database applications more productively and allows end user to access data stored in multiple formats on a wide variety of hardware and operating systems plate forms and network environments. InterBase. Inter base server. InterBase's versioning architecture represents the third and return information to any interabase server. InterBase's versioning architecture represents the their wave of relational system technology. The versioning and decision support both high transactions with minimized looking.

Borland's object orientation developers to built complex client/server systems by constructing modular application components that can be easily developed, tested, maintained, and enhanced and readily assembled into complex application suites. The object-oriented productivity the programming languages enable end-user applications to be constructed with reusable object components. The application constructed from similar components can be easily integrated to allow user to exchange departmental and enterprise resources such as data forms, reports, spreadsheets, and graphics among their desk-top applications. Development effort, Borland has created an object-oriented user interface (OOUI).

## 8. OSI Model

To enable the devices on a network to communicate over different communications link, a uniform set of protocols mush be constructed. The open system interconnection (OSI) model provides the basis for considerable independence between the various complicated operations of data communications. The model divides the work to be performed into tasks arranged sequentially in layers. At each level the process communicates with its corresponding layer in the receiving host by accepting messages from the layer adding control information to the message to the layer immediately below. The process is reversed at the receiving end. Messages are received from the below, control information is stripped off, and the message is passed up to the next layer. The (OSI) layers are illustrated in Fig. 2.

The physical layer is the lowest level of the OSI model. It is concerned with the transmission of a raw bit stream. The layer uses error-detecting codes and host-host messages to convert an unreliable transmission channel into a reliable one. A reliable one. This network layer, in point-to-point network is primarily concerned with routing and congestion.

The data-link layer provides the basic packet delivery functions for the network. The final assembly on leaving packets and the first inspections on arriving packets is

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accomplished at this layer. It adds error correction on the leaving packets and validates checksum data on arriving packets.

The network layer is concerned primarily with provision of services to establish a path, with a predictable quality of serve, between open systems. It is responsible routing datagrams hop over a potentially complex network of individual links.

The transport layer is responsible for reliable delivery of the user messages from one computer to an other, including the conversion the of arbitrary–length messages to the data grams, which the network layer processes. The session layer privies for connections between processes in different hosts. It includes those functions involved in establishing communication between two applications.

The presentation layer perform translation of data formats for example translation between American Standard code for information interchange (ASCII) and Extended Binary Coded decimal interchange Code (EBCDIC) encoding schemes. It performs any conversion that may be required to render the data useable by the application layer. The presentation layer of network communications should not be confused with the frequently used term presentation in discussions concerning the presentation of data to the user. The presentation layer in the OSI model is a network communication layer and does not interface directly with a display device.

The application layer provides a set of network services (file transfer, e-mail, etc.) to the application program application layer is the generic term for all the software, which performs a user-visible function.

## 9. Network Connectivity

The development of a client/server system also requires an under standing of variety of network connectivity issues. These includes issues pertaining to physical media, physical topologies, communication protocols, asynchronous communication services inter networking, and local connectivity support.

### Physical Media

Physical media types are classified as follows: unshielded twisted pair (UTP) shielded twisted pair (STP) coaxial cable, and optical fiber.

### Physical Media

The basic physical topologies for network design are classified as follows:

***Star Topology,*** which provides a central hub though which all messages pass.

***Ring topology,*** in which all the nodes are connected together in a ring, with none having overall control of access to the network.

*Loop Topology,* in which all nodes are connected together in a ring but one o them controls the rest and determines which should use the communication channel.

***Bus Topology,*** which provides a single communications circuit that is shared by ever node, but circuit that is not joined together in a loop.

***Tree Topology,*** in which the nodes are connected together by a branching communication channel.

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## 9.1 Communication Protocols

Data communication protocols coordinate the exchange of information between different network devices. The following network protocol support the workgroup and enterprise model o client / server computing:

***Xerox Network System*** (XNSs) designed to enable users to make use of a range of services on the network: e-mal, electronic document exchange and remote printing documents

***Internet work Datagraph Protocol*** (IDP), designed to perform packet routing function in the XNS

***Routing Information Protocol*** (RIP), which uses IDP to exchange routing information between routers

***Sequential Packet Protocol*** (SPP), that establishes a virtual circuit between the sender and the receiver

***Packet Exchange Protocol*** (PEP), which provides a connectionless protocol for simple request/response-type communications between applications process

***Courier Protocol,*** designed to control to calling of remote procedures that are located and executed on remote computers

***Novell Netware Protocol*** (IPX/SPX), a modified version of RIP used to query and maintenance routing information table on clients and servers

***Sequence Packet Exchange*** (SPX), Which enable server to advertise their names and type of services they provide

***Net BIOS,*** a high level application program interface that was designed to enable programmer to build network application using IBM's PC network

***Apple Talk Protocol Suite,*** which enable to share files across an apple talk network

***Datagram Delivery Protocol*** (DDP), which serves as apple talk network layers protocol

***Transmission Control Protocol*** (TCP), which provide a reliable connection-oriented virtual circuit service for application processes to use for host-o-host communication

***User Datagram Protocol*** (UDP), which provide application processes with an unreliable Datagram Protocol for the transport layer

***Internet protocol,*** which provide an unreliable, connectionless Datagram service for switching data over packet – switch networks

***Internet Control Message Protocol*** (ICMP), used to report errors that occur during the delivery of datagrams though the Internet

### 9.1.1 Asynchronous Communications Services

The sharing of network resources in made possible through the use of asynchronous communication devices that enable users to share moderns. The two basic methods used are parallel and serial communications. Parallel communication is a method in which each bit of a work is sent simultaneously on an individual wire. Serial communication is a method of information transfer in which each bit of character is sent n sequence.

Parallel transmission requires eight wires to convey individual bytes and is therefore

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used mainly for transmission over shot distances e.g., for buses within a computer.

Serial transmission requires some means of converting individual bits of bits to facilitate data transmission. The data is broken into packets by a universal synchronous receiver-transmitter (UART).

### 9.1.2 LAN Communications

The basic requirements of a synchronous communications across a local network are the dial – in – dial – out capabilities of the modem.

Dial –in includes the capability to access file information or run applications.

Either software solutions that make the modem a shared device, dedicated modem pooling servers, or provide that are shared modems attached as a network device accomplishes dial-out services.

### 9.1.3 Internet working

the proliferation of client/server computing has given emphasis to the development of computing infrastructure called internetworking. This concept encompasses the linking of local and enterprise networks through device such as bridge, routers, and gateways. Internetworking devices that correspond with the various levels of OSI model include

***Repeaters:*** bi-directional devices that amplify or regenerate signals in a channel. The repeaters are spaced along log communications channels subject to excessive attenuation or interface.

***Bridges:*** devices that provide communications between networks, particularly local area networks on a local basis.

***Switches:*** devices that create virtual links between individual nodes on different segments and allow multiple simultaneous connections.

***Routers:*** devices that handle specific network-layer protocols used by end nodes to communicate with one another network.

***Gateway:*** devices used to interface networks so that a terminal can communicate with a terminal or computer on another network.

## 10. Network Management

the focus of network management is on administrative control of day–to-day operations such as backup. Configuration. Inventory, version control, software license metering, and virus detection.

The critical issues pertaining to backup are those related to the selection of backup hardware and software, location to backup data, frequency of backup, preservation of file attributes, and the restorations of files.

### 10.1 OSI Network Management

The OSI management model identifies five functional areas of network management:

- Fault management to facilitate fault detection, diagnosis, correction and administration.
- Configuration management to identify, configures and control device on the network.
- Performance management to evaluate the system's reliability and level of performance.
- Accounting management to track and to control the network resource

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- Security management to protect against unauthorized access and use of network resources.

- The OSI management model defines the relationship between managed objects. Each object performs a designated task and consists of a separate piece of software.

### 10.2 SNMP-Based Network Management

The simple network Management Protocol (SNMP) model closely follows the OSI framework. The management information base (BIM) is the base of the object to managed. SNMP management tools include the carriage-Mellon University (CMU) package, which provides a command–line interface to get, and SetNMp MIB variables, and VisiNet from VisiSoft, which provides a graphical user interface.

## 11. Conlusion

the client/ server architecture is increasing in popularity as more and more organizations install network to share resources in a distributed database environment. The architecture of a client/ server system is distinguished by the incorporation of intelligent user workstations as active platforms and interoperability between plate forms and software. The client/server architecture involves multiple computer connected in a network.

Each element of client / server is reviewed: resources haring, distributed processing, relational database, network connectivity, and network management issues. In addition, the role of structured qurrey languages (SQL) as an essential link in client / server computing is summarized and an overview of the open system interconnection (OSI) standards for network development is provided.

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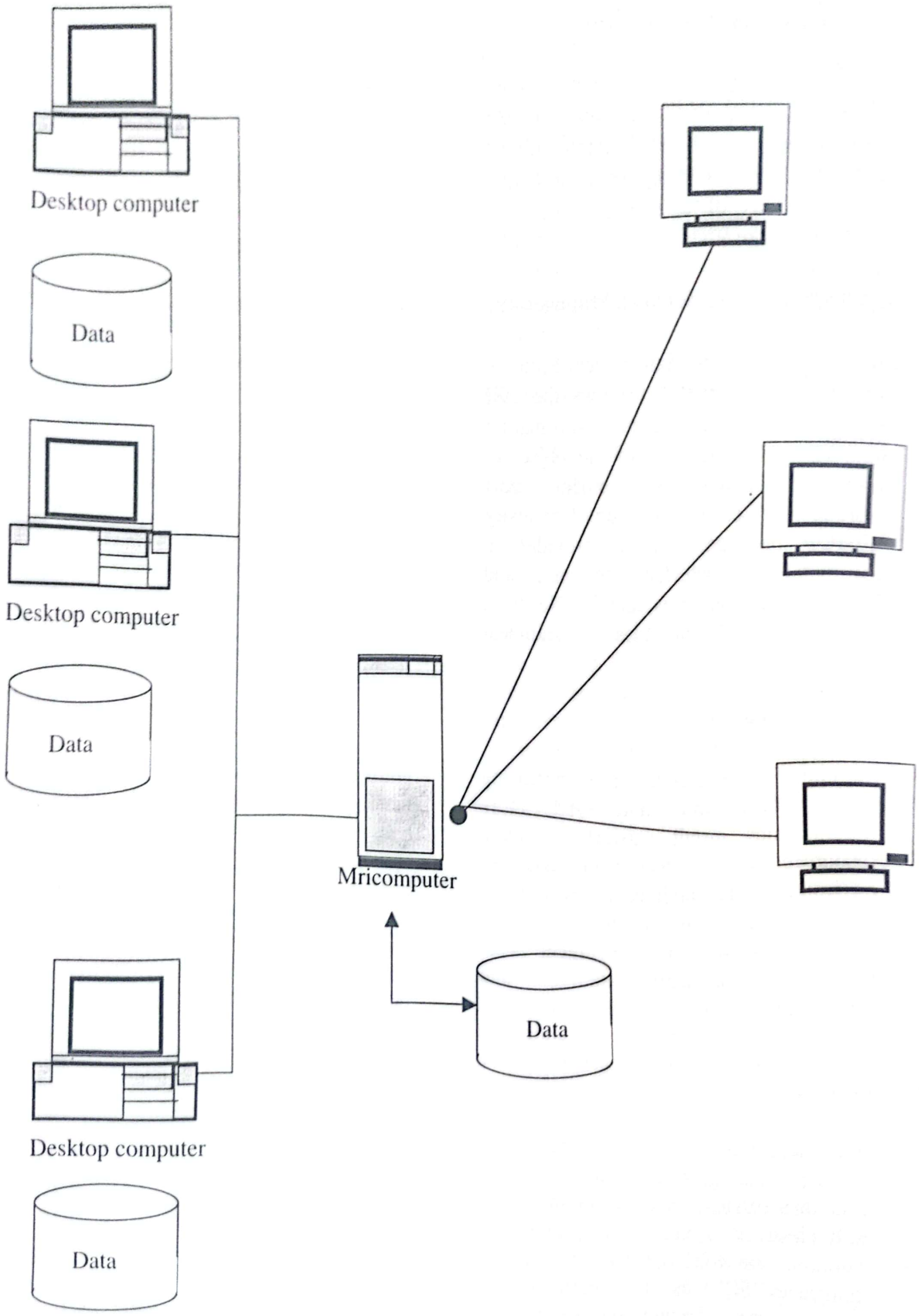



**Figure 1 Distributed database architecture**

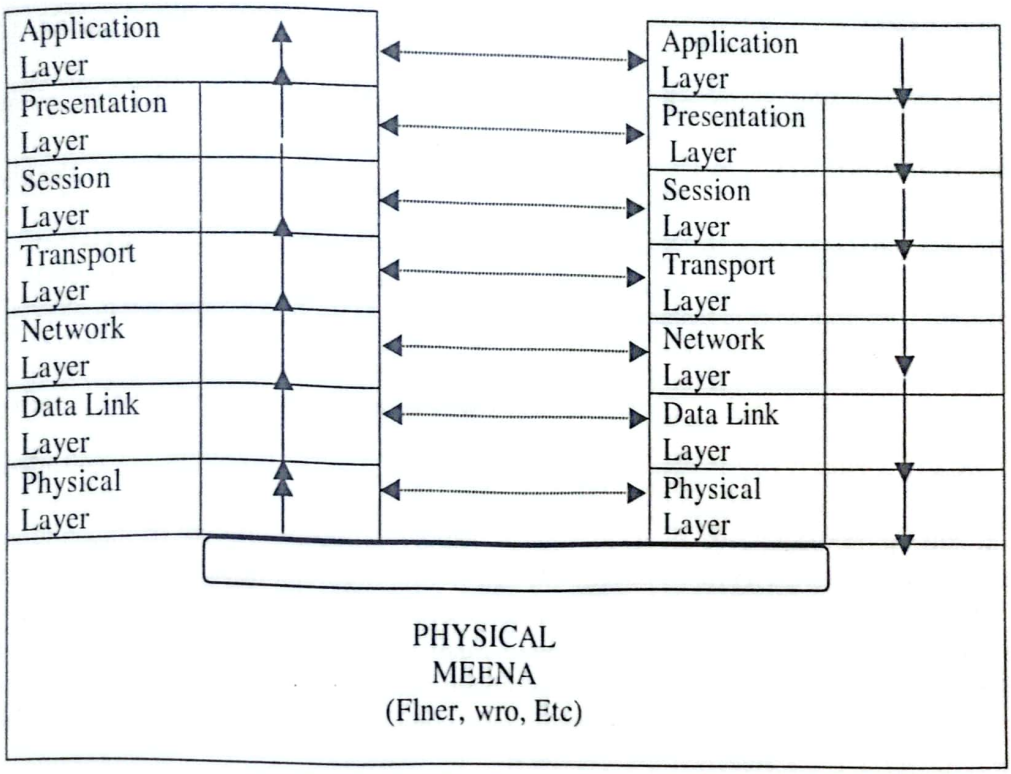



**Figure 2: OSI seven-layer model.**

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