OSI MODEl & TCP/IP MODEL

The international organization for standardization (OSI) established the open system information (OSI) established the open system interconnection (OSI) reference model

Each layer deals with a particular aspect of network communication.
Exchange of energy

What is OSI model

The OSI model is a logical and conceptual model that defines network communication with other systems.

The open system interconnection (OSI) model also defines a logical network and effectively describes computer packet transfer by using various layers of protocol.

Communication Architecture

- Strategy for connecting host computers and other communicating equipment
- Define necessary element for data communication between devices
- A communication architecture, therefore defines a standard for the communication hosts
- A programmer formats data in a manner defined by the communication architecture and passes it on the communications software.
- Separating communication functions adds flexibility.
- For example, we do not need to modify the entire host software to include more. communication devices.

Characteristics of the OSI model

A layer should only be created where the definite level of abstractions are needed.

The function of each layer should be selected as per the internationally standardized protocols

The number of layers should be large so that functions should not be put in the same layer. At the same time. It should be small enough so that architecture doesn't become very complicated.

Changes made in one layer should not need changes in other layers.

The OSI reference model

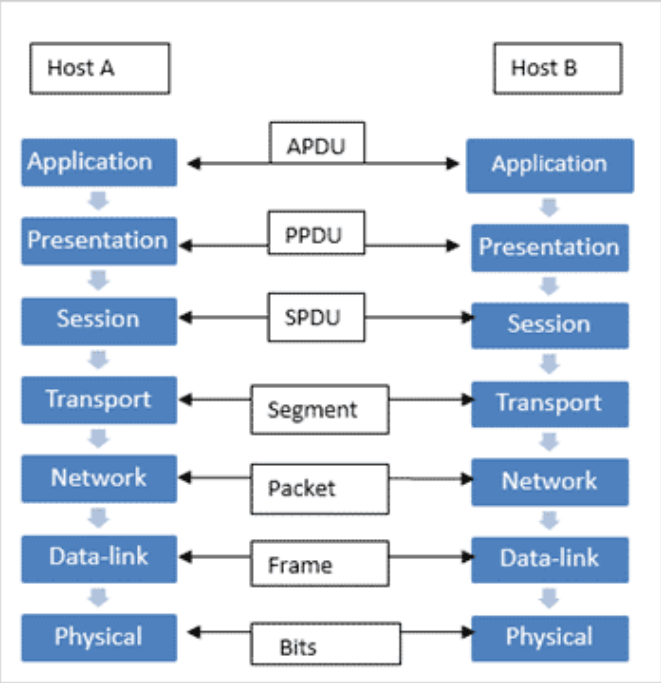
In the OSI model, each layer rules on the next lower layer to perform primitive functions.
every level should be able to provide service to the next higher layer.

The osi model is now considered the primary architectural model for inter computer communication.

The osi model describes how information or data makes its way from application Programmes such as spreadsheets through a network medium such as wire to another application Programmes located on another network.

The osi reference model divides the problem of moving information between computers over a network medium into seven smaller and more Manageable problems.

This Separation into smaller more manageable functions is known as layering.



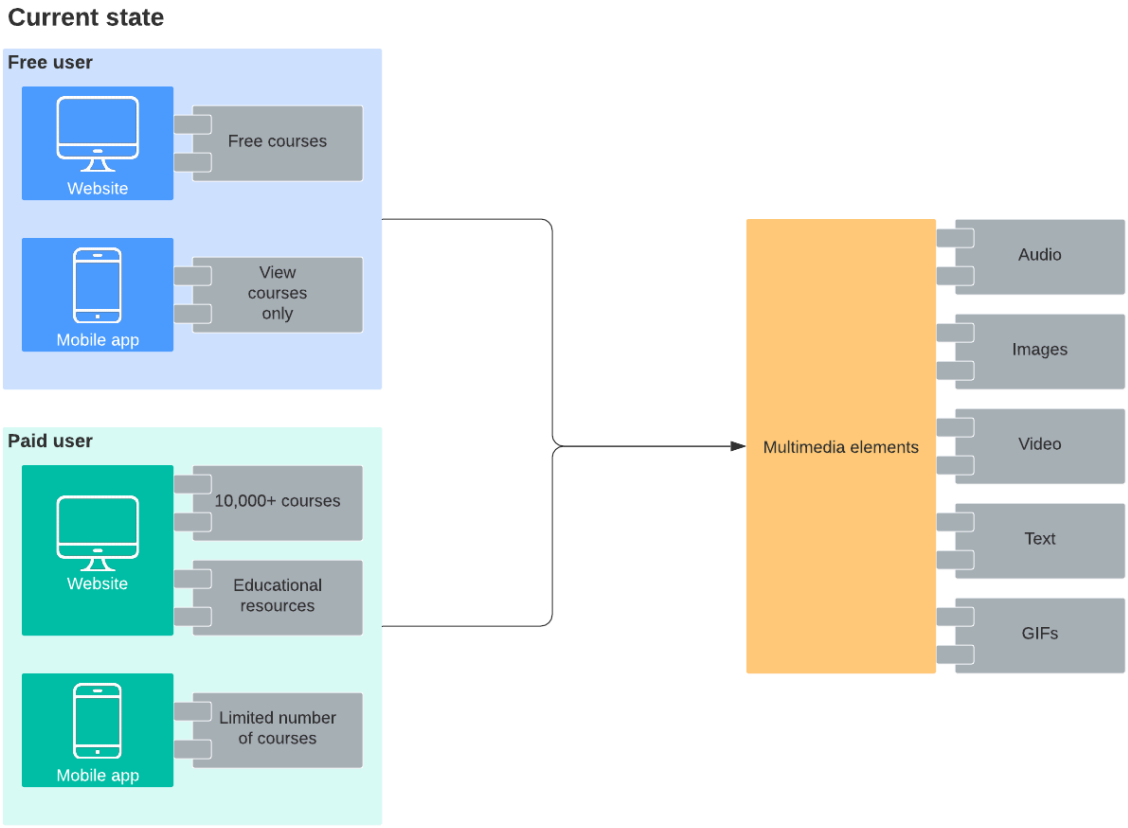
Advantages of OSI model

- It helps you to standardize the router, switch, motherboard, and other hardware.
- Reduces complexity and standardize interfaces
- Facilitates modular engineering
- Helps you to ensure interoperable technology
- helps you to accelerate the evolution
- protocols can be replaced by new protocols when technology changes.
- provide support for connections-oriented services as well as connectionless service.
- It is a standard model in computer networking.
- support connectionless and connection-oriented services
- It offers flexibility to adapt various types of protocols.

Disadvantages of OSI model

- Fitting of protocols is a tedious task
- you can only use it is a reference model
- it doesn't define any specific protocol.
- In the OSI network layer model, some services are duplicated in many layers such as the transport and data link layers.
- layers can't work in parallel as each layer needs to wait to obtain data from the previous layer.

Application layer



The top layer of the OSI model

Provide a set of interfaces for seeing and receiving applications and to use network services, such as message, handling and database query processing.

- **Responsibility:-** The application layer is responsible for providing services to the user.

- Example of application layer or applications such as file transfer, electronic mail, remote layer etc.

At the very top of the OSI reference model stack of layers we find the application layer which is implemented by the network applications. These applications provide the data. which has to be transmitted over the network. The layer also serves as a window for the application services to access the network and for displaying the receiving information to the user.

- Example:- Applications-browsers, skype, messenger

- Note:- The application layer is also called the desktop layer.

Functions of the application layer

- **Network virtual terminal:-** It allows to user a log on to a remote host

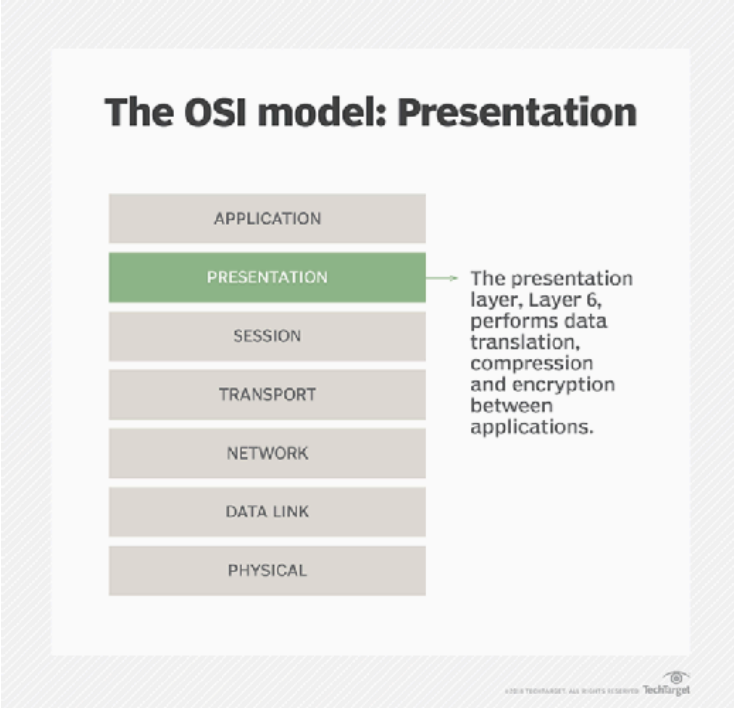
- **FTAM:-** File transfer access and management This application allows a user to access files in a remote host, retrieve files in a remote host and manage or control files from a remote computer.

- **Mail:-** services provide email service

- **Directory services:-** This application provides distributed database sources and access for global information about various objects and services.

- **Note:-** OSI model acts as a reference model and its not implemented on the internet because of its late invention. The current model being used is the TCP/IP model.

Presentation layer



- Manage data format information for networked communication (the network translator)

- For outgoing messages, it converts data into a generic format for network transmission; for incoming messages, it converts data from the generic network format that the receiving application can understand.

- This layer is also responsible for certain protocol conversions , data encryption/decryption, or data compression, decompression.

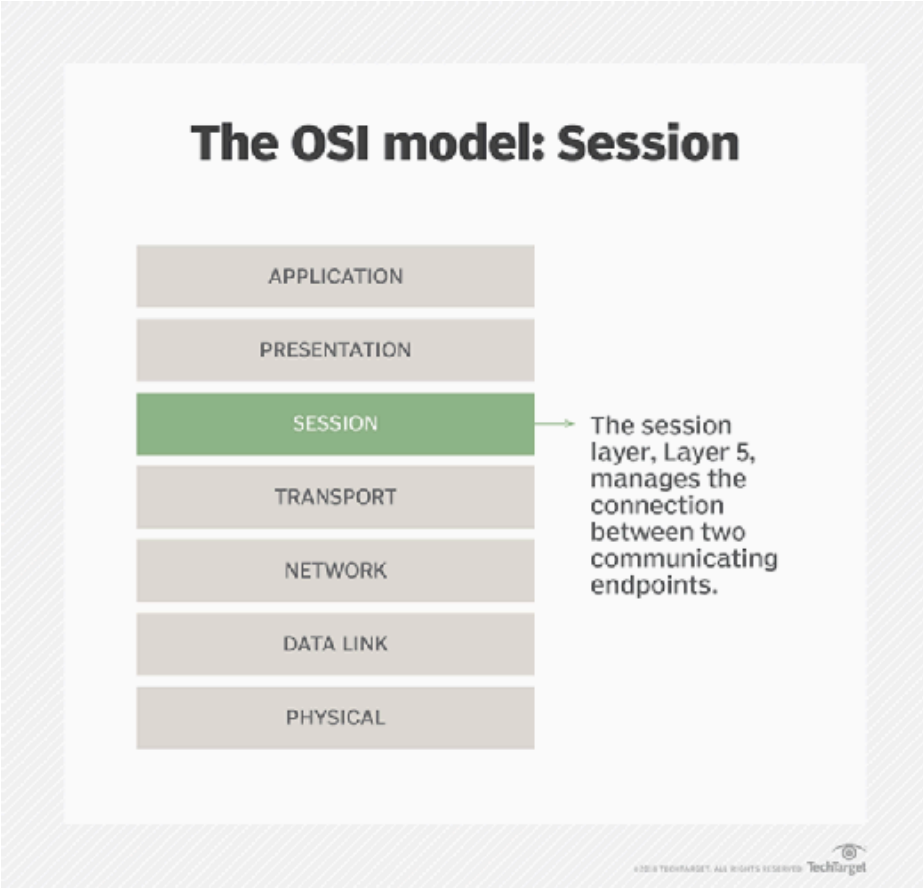
- A special software facility called a 'redirector' operates at this layer to determine if a request is network related or not and forward network-related requests to an appropriate network resource.

- The presentation layer is also called the Translation layer. The data from the application layer is extracted here and manipulated as per the required format to transmit over the network.

Functions of the presentation layer

- **Translation:-** For example ASCII to EBCDIC
- **Encryption/Decryption:-** Data decryption translates the data into another form or code. The encryption data is known as the cipher text and decrypted data is known as plain text. A key value is used for encrypting as well as decryption data.
- **Compression:-** Reduces the number of bits that need to be transmitted on the network.

Session layer



- Enables two networked resources to hold ongoing communications (called as sessions) across a network (dialog session)

- Applications on either end of the sessions are able to exchange data for the duration of the sessions the layers are:- Responsible for initiating, maintaining and terminating sessions.

- Responsible for security and access control to session information (vice session participant identification).

- Responsible for synchronization process services, and for checkpoint services.

- The layer is responsible for the establishment of connection, maintenance of sessions, and authentication and also ensures security.

Functions of the session layer

- **Synchronization:-** this layer allows a process to add a checkpoint that is considered a synchronization point in the data. these synchronization points in the data. These synchronization points help to identify the error so that the data is re-synchronized properly, and the end of the messages are not cut permanently and data loss is avoided.

- **Dialog controller:-** The session layer allows two systems to start communication with each other in half or full-duplex.

- **Note**
- All the below 3 layers (including the session layer are integrated as a single layer in the TCP/IP model as the ??plication layer).

- -Implementation of these 3 layers is done by the network application itself. These are also known as upper layers or software layers.

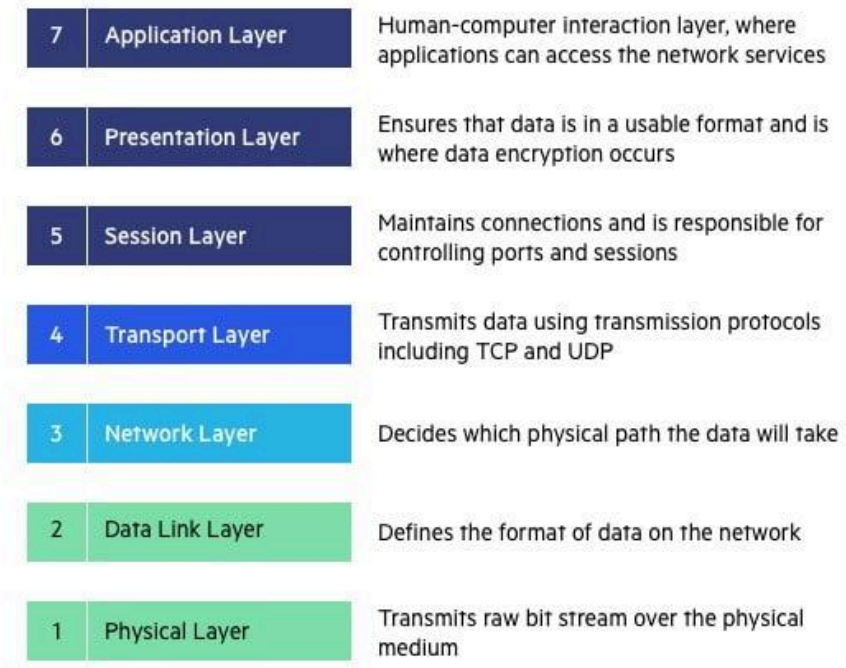
- device or protocol use:- NetBios, PPTP

- For Example:- Let us consider a scenario where a user wants to send a message through some messenger application running in his browser.

- The 'messenger' here acts as the application layer which provides the user with an interface to create the data. This messenger or so called data is compressed, encrypted (if any secure data)

- and converted in bits (0's and 1's) so that it can be transmitted.

Transport layer



- Manage the transmission of data across a network

- Manage the flow of data between parties by segmenting long data streams into smaller data chunks (based on allow 'packet' size for a given transmission medium)

- Reassemble junks into their Original sequence at the receiving end.

- provides Acknowledgement of successful transmissions and requests resend for packets which arrive with errors.

- Imagine you are sending a package through the email. The transport layer is like the postal service for your digital data. It takes care of dividing your message into smaller parts(called segments) so they can fit through the network. it also makes sure these parts reach their destination and puts them back together correctly**

- **Segmentation and Reassembly:**- Just like breaking a bug message into smaller pieces to fit in envelopes, the transport layer breaks your data into segments. at the receiving ends, it puts these segments back together to reconstruct your original message.

- **Service port addressing:-** Each segment gets an address like a room number in a building. This address helps the transport layer deliver the segment to a right place in the receiving device, ensuring they reach the correct application.

- Now, let's talk about the two main service provided by the transport layer:

- **Connection-oriented service:-** Think of this like a phone call, first you establish a connection (dialing the number) then you take (data transfer), and finally you hang up (termination). This service is reliable because it gets confirmation that each segment arrived safely by sending the next one.

- **Connection less service:-** This is more like sending a text message. you just send the message without waiting for confirmation. It's faster but not reliable because there's no guarantee that all segments will reach their destination.

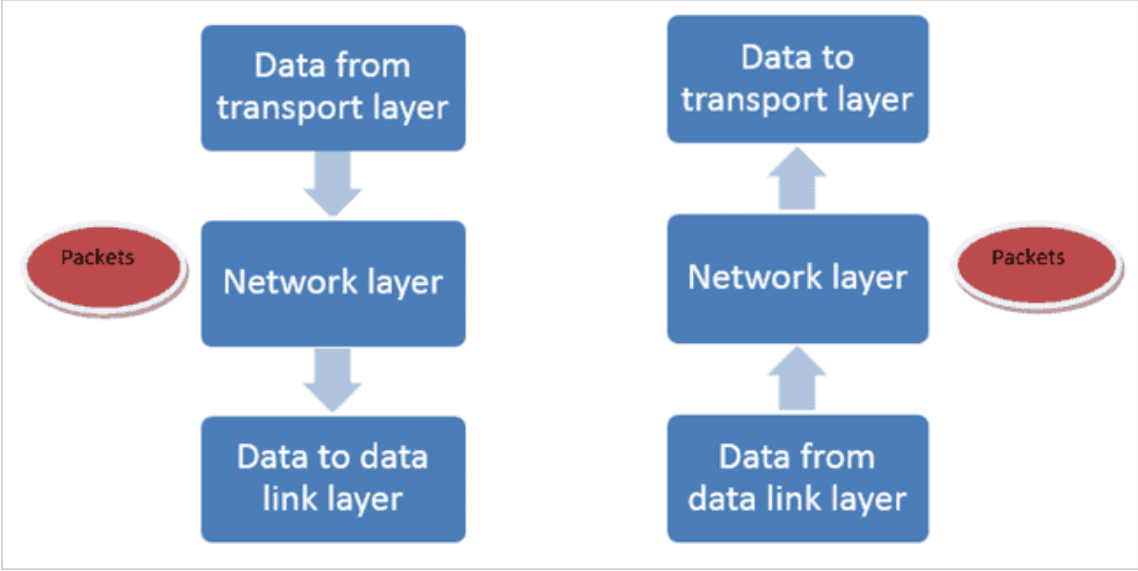
- Examples of protocol used in the transport layer include TCP(transmission control protocol) and UDP(user datagram protocol)**

- **TCP:-** It's like sending a registered letter. you know it there because the receiver acknowledges receipt of each segment.

- **UDP:-** This is more like sending a postcard. It's faster but there's no guarantee it will arrive or be in order.

- Other examples like Netbios and PPTP are specified protocol used for different purposes, like networking in window system or setting up virtual network (VPN)

Network layer



Handle addressing messages for delivery, as well as translating logical networks addresses and names into their physical counterparts.

Responsible for deciding how to route transmission between computers.

This layer also handles the decision needed to get data from one point to the next point along a network path.

Network layer points

This network layer helps send data between different devices on different networks.

It decides the best path for data to travel (routing) from one device to another.

It uses IP addresses to identify devices uniquely and send data to the right place.

Routers and switches are devices that work at the network layer.

Routing

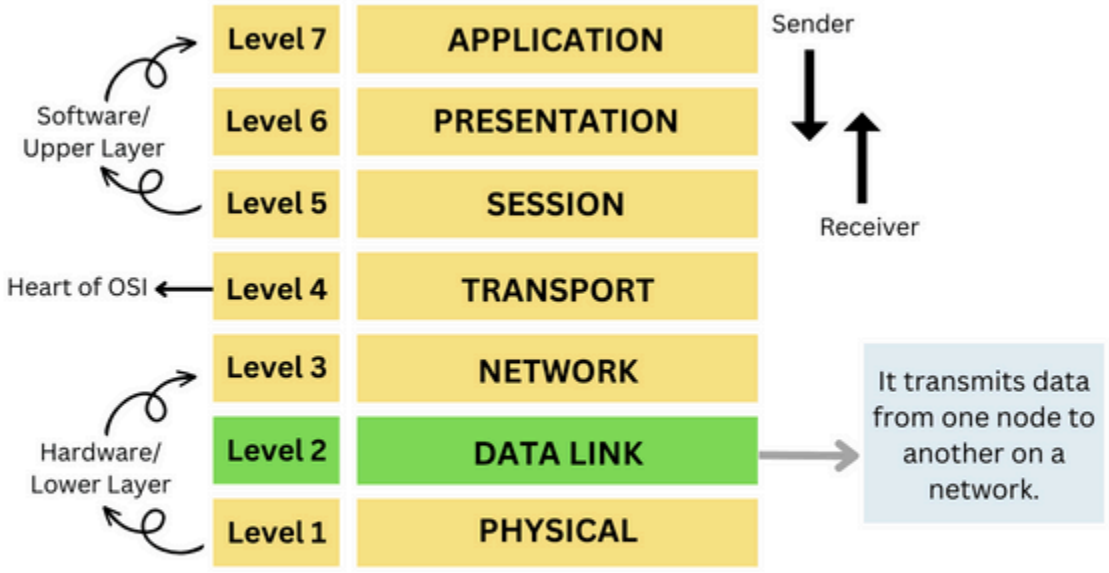
Imagine you're driving from one way to another. The network layer is like a Gps that helps your data packets(think of them as small packages of information) find the best route to reach their destination. It looks at all the possible roads (or routers) and picks the fastest or shortest one.

Logical addressing

Each device connected to the internet gets a unique address, like a house address. The network layer uses these addresses (Ip address) to make sure your data goes to the right place. It's like putting the sender's and receiver's address on an envelope before mailing it.

Note:- The network layer is like a traffic controller for data traveling between different places on the internet. it decides the best path for data to take, just like how a GPS finds the fastest route for a car. It used IP address to travel data packets and send them to the right destination, similar to how addresses are used as an envelope for mail delivery. This layer ensures that data gets to where it needs to go across different networks. like a bridge connect various ports of a city. Rather Routers and switches tools that work at the network layer to make sure data reaches its destination efficiently and reliably.**

Data link layer



The OSI Model: Data Link Layer

Handles special data frames(packets) between the network layer and the physical layer.

At the receiving end, this layer packages raw data from the physical layer into data frames for delivery to the network layer.

At the sending end this layer handles conversion of data into raw formats that can be handled by the physical layer.

The data link layer is like a bridge that ensures data gets from one device to another on the same network without errors.

Its Main jobs is to make sure data transfer between nodes (like computers or devices) is error-free over the physical layer (the actual wires or wireless signals used for communication).

Sublayer of data link layer

Logical link control (LLC):- This part deals with errors checking and flow control within a network. It helps manage data transmission between devices.

Media access control (MAC):- Mac is responsible for controlling access to the network where multiple device are trying to send data at the same time.

Functions of the data link layer

Framing:- Imagine you're sending a letter. The data link layer puts the letter into an envelope (frame) with sender and receiver's address (Mac address) so it can be delivered correctly.

Physical addressing:- Mac addresses are link unique Ids for devices on the network. The link layer adds these addresses to frame for accurate delivery.

Error control:- It checks if any frames were damaged during transmission and ask them be sent again if needed, ensuring data arrives intact.

Access control:- In shared networks, it divides which devices can send data at any given time, preventing Collision and ensuring efficient communication.

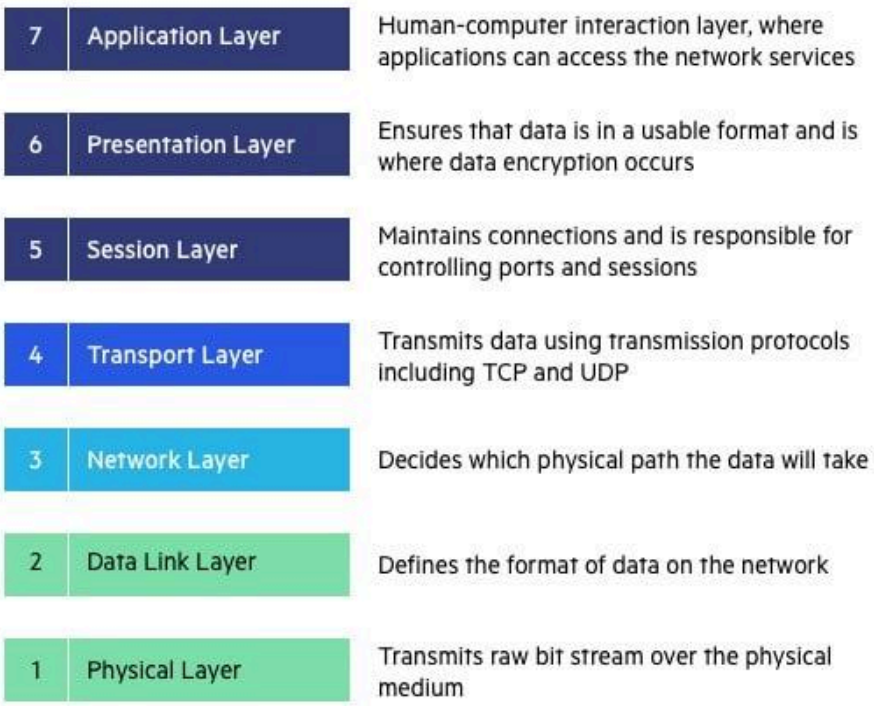
Role of device and terms

Nic(Network interface card):- This is like a passport for devices to connect to a network. It handles the data link layer task for the device.

Switches and bridges:- These are devices that work at the data link layer, helping data packets find their way to the right devices on the networks.

In simple terms, the data link layer makes sure data travel smoothly between devices on the same network, like ensuring letters are properly addressed and delivered without errors.

Physical layer



Converts bit into electronic signal for outgoing message

Convert electronic signal into bits for incoming messages

This layer manage the interface between the computer and the network medium (coax, twisted pair, etc)

This layer tell the driver software for the mac (media Attachment unit, ex:- network interface cards (Nics, modem, etc))

The bottom layer of the OSI model

Thy physical layer is responsible for movements of individuals bits from one hop (node)- to the next.

What is physical layer

Imagine the physical layer as the foundation of a building. It's the lowest layer in the OSI model, responsible for the actual physical connection between devices like computers, routers or Smartphones in a network.

Functions of the physical layer

Bit synchronization:- This is like having a clock that keeps everyone in sync. The physical layer provides a clock signal that controls when bits are sent and received. This way devices know when to start and stop sending bits, ensuring smooth communication.

Bit rate control:- Think of this as a speed limit on a road. The physical layer defines how fast it can travel. measured in bits per second. a faster bit rate means more data can be send and received quickly.

Physical topologies:- Imagine different ways devices can be connected in a network, like how houses are arranged in a Neighbourhood. The physical layer specifies these arrangements, such as bus (devices connected in a line), a star (devices connected to a central point), or mesh (devices interconnected in multiple ways.

Transmission nodes:- This is about how data flows between devices. These are three nodes.

Simplex:- Data flows in one direction only, like a radio broadcast.

Half duplex:- data can flow in both direction, but not simultaneously, like a walkie-talkie where you take turns talking.

Full duplex:- data flows in both directions simultaneously like a phone call where both parties can speak and listen at the same time.

Devices and example

Hub:- Acts like a central meeting point where devices connect in a star topology.

Repeater:- Boost signal to extend the range on a network.

Modem:- Converts digital data from computers into signals that can travel over phone or cable lines.

Cable:- physical wire or Fiber that carries data between devices.

Remember, the physical layer, along with the data link layer, are often called the lower or hardware layer because they deal with the physical aspects of networking.

The OSI model is a conceptual framework that explains how data is transmitted over a network. It is a 7-layer model that breaks down the process of data transmission into smaller, more manageable parts.

Physical layer (layer 1)

The physical layer is responsible for transmitting raw bits over a physical medium, such as a cable or wireless connection.

It defines the physical means of data transmission, including voltage levels, cable specifications, and wireless transmission protocols

Data link layer (layer 2)

The data link layer is responsible for framing, error detection, and correction of data packets.

It provides a reliable means of transmitting data between two devices on the same network.

Network layer (layer 3)

The network layer is responsible for routing data between different networks.

It provides logical addressing and routing of data packets between different networks.

Transport layer (layer 4)

Transport Layer provides transparent transfer of data between end users, providing reliable data transfer services to the upper layers. The transport layer controls the reliability of a given link through flow control, segmentation and desegmentation, and error control.

Session layer(layer 5)

The session layer is responsible for establishing, maintaining, and terminating connections between devices.

It provides a way for devices to communication with each other and maintain a connection

Presentation layer (layer 6)

The presentation layer is responsible for data formatting and compression.

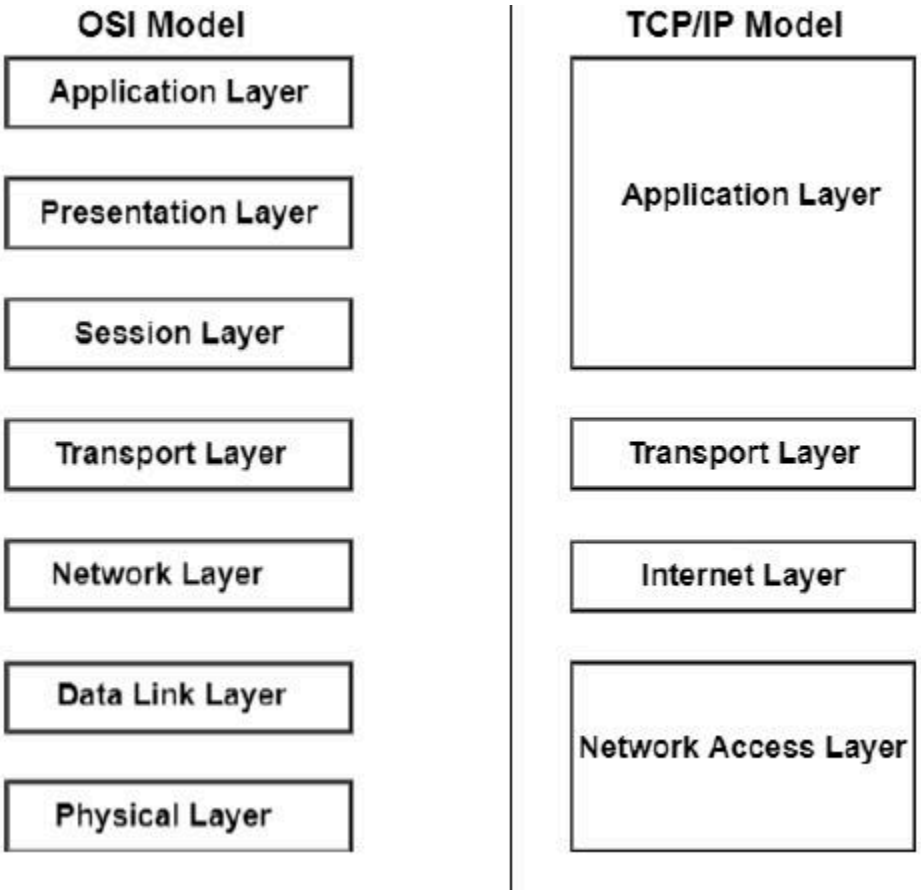
It provides a way for devices to communicate with each other and understand the format of the data being transmitted.

Application layer (layer 7)

The application layer is responsible for providing services to end-user applications.

It provides a way for devices to communicate with each other and provides services such as email, file transfer, and web browsing.

TCP/IP Model



Layer 1 Network interface

Function:- This layer deals with physical connection and hardware. It's responsible for sending and receiving data between your devices on the network.

Examples:- When you plug an ethernet cable into your computer to connect to the internet, or when you connect to a wifi network using a wireless adapter, you're operating at the network interface layer.

Layer 2 Internet

Function:- This layer handles addressing and routing of data across the network. It uses Ip address to identify devices and determine the best path for data to travel.

Examples:- When you type a website address like www.example.com into your browser, your devices use the internet layer to convert that address into an IP address (like 192.168.1.1) Which is then used to locate the server hosting the website.

Layer 3 Transport

Functions:- The transport layer manages the delivery of data between devices. It decides how much data to send at a time, ensure data arrives in the correct order, and handle any errors.

Examples:- when you download a large file from the internet, the transport layer breaks that file into smaller chunks called packets. It then sends these packets to your device, ensuring they arrive in order and resembles them into the original file.

Layer 4 Application

Functions:- This layer where applications and users interact with the network. It provides services like email, web browsing, file transfer etc. using specific protocols.

****Examples**:-** When you send an email, the application layer uses a protocol like **SMTP(simple mail transfer protocol)** to compose , send, and receive emails. Similarly when you browse a website the application layer uses **HTTP (hypertext transfer protocol)** to fetch and display web pages.

Routing tables

What it is:- A routing table is like a map that routers use to determine where to send data packets in a network. It contains information about different destinations like other computers or devices and the best path routers to reach them.

Examples:- Imagine you're driving and have a map that shows different routers various destinations. A routing table is similar but for routers in a network, helping them choose the best path for data packets based on destination in address.

Routing metrics

What are they:- Routing metrics are criteria or factors used by routers to determine the best path for sending data packets. These metrics can include things like distance, speed, reliability cost, or traffic road on a network link.

Example:- If you're choosing a route to drive, your might consider metrics like distance(shortest route) , traffic(least congested) or road conditions fastest route, similarly, routers use metrics like hop count (numbers of routes between source and destination), bandwidth available data transfer rate or latency (delay in data transmission to select optimal path).

Notes by Mahesh Shukla