OSI layers and explanations

conceptual overview of the hardware and software functions of a network

- **Layer 7** Application
- **Layer 6** Presentation
- **Layer 5** Session
- **Layer 4** Transport
- **Layer 3** Network
- **Layer 2** Data Link
- **Layer 1** Physical

Encapsulation   **Decapsulation**

Layer 1: Physical layer

Network needs physical channel throguh which it can move bits of data between the systems. Layer 1 of the OSI model defines method of moving data between the devices.
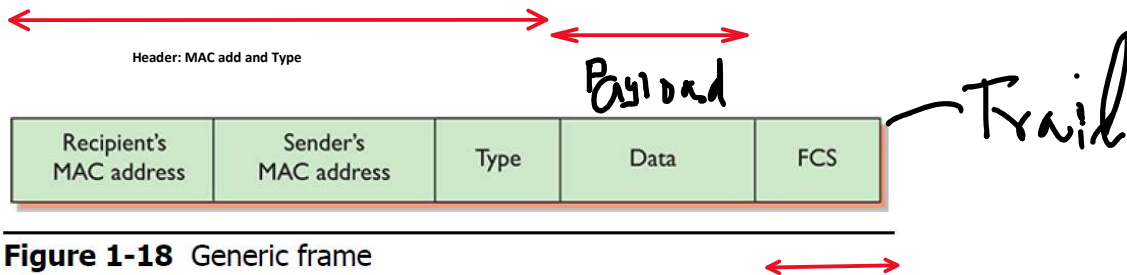eg: UTP cables(unshielded twisted pair) ; 4 wires , it can send and receive data
  Hub : Dumb device simply forward the data that received to all the connected devices
 Copper cables, fibre optics , Wifi signals , radio Waves

The unit of data specified by a protocol at each layer of the OSI seven-layer model is called a protocol data unit (PDU).

MAC address : 48 bit unique value , Media access control (Burned into the ROM chip)

Header: MAC add and Type

Payload   **Trail**

Recipient's MAC address	Sender's MAC address	Type	Data	FCS

Figure 1-18 Generic frame

The physical layer refers to the **physical communication medium and the technologies to transmit data across that medium.** At its core, data communication is the transfer of digital and electronic signals through various physical channels like fiber-optic cables, copper cabling, and air. The physical layer includes standards for technologies and metrics closely related with the channels, such as Bluetooth, NFC, and data transmission speeds.

Layer 2: Data Link Layer (deals with the MAC add , frame is PDU on this layer)

The data link layer refers to the technologies used to connect two machines across a network where the physical layer already exists. It manages data frames, which are digital signals encapsulated into data packets. Flow control and error control of data are often key focuses of the data link layer. Ethernet is an example of a standard at this level. The data link layer is often split into two sub-layers: the Media Access Control (MAC) layer and Logical Link Control (LLC) layer.

Type : which inidcates what's encapsulated in the frame
Data : data encapsulated in frame
FC: frame check sequence (Cyclic redudancy check : NIC uses to verify if the data is arrived intact)

Hub : Hub is a dumb device, it's just a repeater, when its received a frame, the hub made a copy and send the copy to all the connected ports except the one its recevied

  The NIC with the MAC add that's present in the frame will process that frame.

Switch : sends the frame only to the interface associated with the destination MAC add

FCS : it's only 4 bytes but a generic frame size is 1500 Bytes. FCS check if the 1500 bytes in the data are correct.

NIC : Layer 2 device

How does NIC/devices know the MAC address of the NIC which it's sending data ?

"Broadcast" , is send to the network asking the MAC address

When a NIC send a frame using the broad cast add "FF-FF-FF-FF-FF-FF " , every sinc NIC on the network receives and process the frame.

Senders Operating System hands some data to it's NIC. The NICs build the frame to transport that data to the receiving NIC
It adds the FCS (4 bytes) and then add the data. Then the MAC add of source, it's own MAC , destination MAC add , and send it thorough the cable.

Unicast: A frame addressed specifically to another device's MAC add is called a unicast frame

Beyond the Single Wire—Network Software and Layers 3–7

Simple network is that computers need to broadcast to get the MAC add, it works for small networks.Millions of computers broadcasting all, no data could get you through the network

Network Layer : Layer 3

The network layer is concerned with concepts such as routing, forwarding, and addressing across a dispersed network or multiple connected networks of nodes or machines. The network layer may also manage flow control. Across the internet, the Internet Protocol v4 (IPv4) and IPv6 are used as the main network layer protocols.

 the PDU unit = Packet
IP add: unique logical address
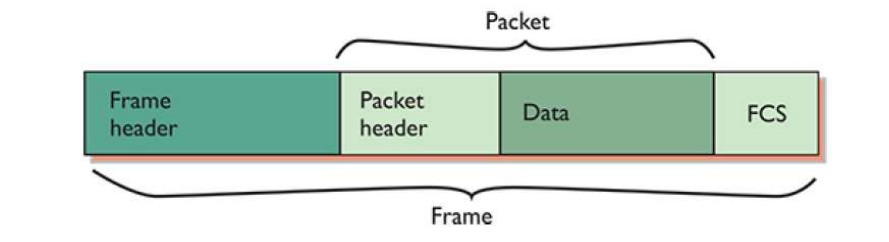
Layer 4 : Segementation and Assembly (Transport layer)

The primary focus of the **transport layer is to ensure that data packets arrive in the right order, without losses or errors, or can be seamlessly recovered if required.** F**low control, along with error control, is often a focus at the transport layer.** At this layer, commonly used protocols include the Transmission Control Protocol (TCP), a near-lossless connection-based protocol, and the User Datagram Protocol (UDP), a lossy connectionless protocol. TCP is commonly used where all data must be intact (e.g. file share), whereas UDP is used when retaining all packets is less critical (e.g. video streaming)

This where segmentation happening, the data is big chunks and it needs to be chopped to fit into the packet. This is called segmentation and the receving computer does the resassembling

Transport protocol break the data into chunks called segments and give each segment some type of sequence number.

Connection oriented (TCp : Transimission control protocol) and connectionless Communication (UDP : User datagram protocol)

SMTP : port 25 : Simple mail transfer protocl used for sending email messages, require that the e-mail client and server verify that they have a connection before a message is sent.

Port : 1-65536, is a logical value assigned to a specific application or service

Layer 5 : Session Layer

Session layer

The session layer is responsible for network coordination between two separate applications in a session. A session manages the beginning and ending of a one-to-one application connection and synchronization conflicts. Network File System (NFS) and Server Message Block (SMB) are commonly used protocols at the session layer. Session layer handles all the sessions for the system, the session layer initiates sessions, accept incoming sessions , open and closes exisiting sessions.
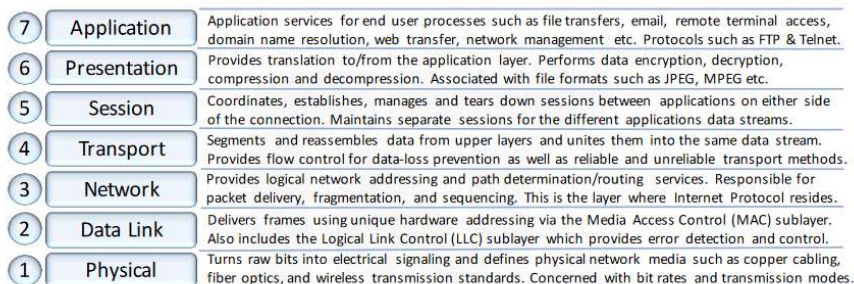
Layer 6 : Presentation Layer

Presentation layer
The presentation layer is primarily concerned with the syntax of the data itself for applications to send and consume. For example, Hypertext Markup Language (HTML), JavaScipt Object Notation (JSON), and Comma Separated Values (CSV) are all modeling languages to describe the structure of data at the presentation layer.

Presentation layer translates data from lower layers into a format usable by the application layer and vice versa
Encryption and decryption ,

Layer 7 : Applicaiton Layer

Application layer

The application layer is concerned with the **specific type of application itself and its standardized communication methods.** For example, browsers can communicate using HyperText Transfer Protocol Secure (HTTPS), and HTTP and email clients can communicate using POP3 (Post Office Protocol version 3) and SMTP (Simple Mail Transfer Protocol).
end user softwares, web browser
End user interface, APIs
https , https

7	Application	The layer where users interact with data using software to allow network-facing apps to function.
6	Presentation	Manipulates data and turns it from a bitstream into data that apps can decode and use.
5	Session	Responsible for commencing communication between devices and determining session length and transmitted data accuracy.
4	Transport	Establishes direct communication between connected devices by assessing the correct speed for data transmission.
3	Network	The layer where data is sent between connected devices within established stable network connections.
2	Data Link	Refers to communication between locally-connected devices like on-premise workstations and routers.
1	Physical	Covers the physical infrastructure and equipment needed to transfer digital bitstream-converted data.

7	Application	Application services for end user processes such as file transfers, email, remote terminal access, domain name resolution, web transfer, network management etc. Protocols such as FTP & Telnet.
6	Presentation	Provides translation to/from the application layer. Performs data encryption, decryption, compression and decompression. Associated with file formats such as JPEG, MPEG etc.
5	Session	Coordinates, establishes, manages and tears down sessions between applications on either side of the connection. Maintains separate sessions for the different applications data streams.
4	Transport	Segments and reassembles data from upper layers and unites them into the same data stream. Provides flow control for data-loss prevention as well as reliable and unreliable transport methods.
3	Network	Provides logical network addressing and path determination/routing services. Responsible for packet delivery, fragmentation, and sequencing. This is the layer where Internet Protocol resides.
2	Data Link	Delivers frames using unique hardware addressing via the Media Access Control (MAC) sublayer. Also includes the Logical Link Control (LLC) sublayer which provides error detection and control.
1	Physical	Turns raw bits into electrical signaling and defines physical network media such as copper cabling, fiber optics, and wireless transmission standards. Concerned with bit rates and transmission modes.

Tech Lesson: The OSI Reference Model

7	Application Data	FTP Telnet, SSH HTTP
6	Presentation Data	JPEG, MPEG TLS, LPP
5	Session Data	SCP NetBIOS PAP
4	Transport Segment	TCP UDP ESP
3	Network Packet or Datagram	IP ICMP EIGRP
2	Data Link Frame	Ethernet VLANs 802.11 WiFi
1	Physical Bits	Bluetooth DSL ISDN

This diagram shows common network devices and the layer at which they function. In addition, we have some examples of protocols at each layer.

If a device works at any specific layer it also works at all the layers below it. Servers and host computers work at all layers of the OSI model, whereas network devices are primarily concerned with the bottom 4 layers which are also known as the "Networking Layers".

Layer 4 Devices
Firewall

Multiservice Router

Multilayer Switch

Layer 3 Devices
Router

Layer 2 Devices
Switch

Layer 1 Devices
Hub/repeaters
Cables & Media