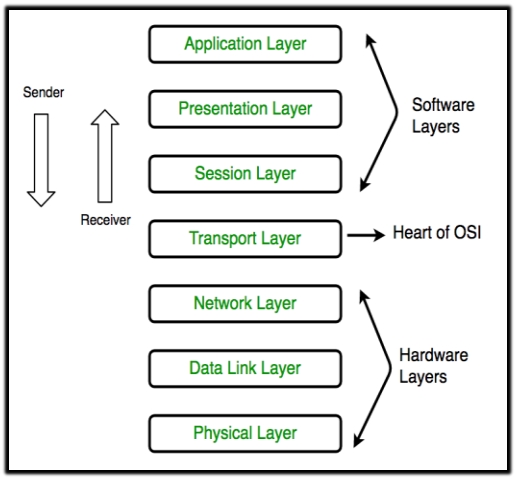
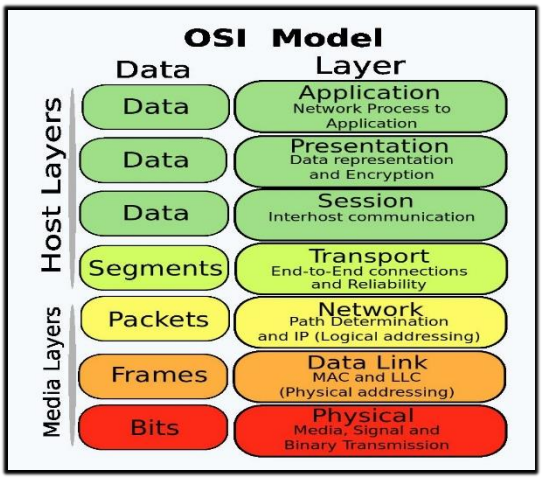
V. OSI Model

- The ***Open Systems Interconnection Basic Reference Model*** (**OSI**) is a **logical** model that describes how information from a software application in one computer moves through a physical media to the application in another computer.
- OSI consists of **seven layers**, and each layer performs a particular network task.
- OSI model was developed by the **International Organization for Standardization** (**ISO**)
- Each layer is assigned a particular task or more and some tasks may be performed by more than one layer.
- task assigned to each layer can be performed independently.
- A given Protocol is responsible for implementing the task/s or a part of task in any layer or more layers of the OSI model.

Layers	Layer Name	General function
7	**Application (upper layer)**	allow software to send and receive information and present meaningful data to users (provide the services to the users)
6	**Presentation**	Translates, encrypts and compresses data
5	**Session**	Creates communication channel (session) between devices. manage (ensuring they remain open and functional , monitoring users) the session , terminate sessions and payment bills issues
4	**Transport**	breaks the sending data into "**segments**", and control its flow, and checking if it was received correctly or not
3	**Network**	Convert the segments into " **packets**" after adding the logical (**IP**) address, routing packets by the best path to destination.
2	**Data Link**	Convert the packets into "**frames**" after adding the physical (**MAC**) address, and performs error checking
1	**Physical (lower layer)**	defines the media connecting the devices, and is transmission the data as stream of bits



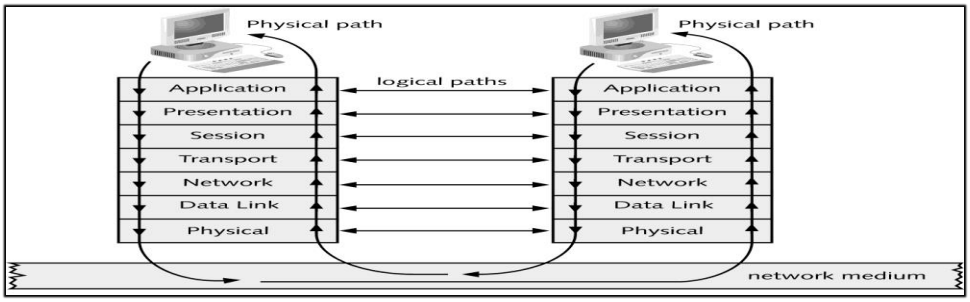


❖ ***The seven layers of the OSI model can be divided into two groups:***

- The **upper layers (7, 6, 5)**
  - Implemented only in software (sometimes called the **software** layers),
  - Known as **application layers** because they Deals with **application issues**: the user interface, data formatting, and the application access.
- The **lower layers (4, 3, 2, and 1)**
  - Transport & network layers (3&4) are implemented in software
  - physical and data link layers (1&2) are implemented in HW and SW
  - **lower layers,** Known as the **data flow layers** because they Deal with **data transport issues**: control the physical delivery of messages over the network.

❖ ***OSI Model and transmission between network nodes***

- **In the source node**, transmission **started from application down** to **physical** layer**.**
- **In the destination node**, the message received by **physical up to application** layer



1) Layer 7: APPLICATION Layer

- serves as an interface for users to provide them the network services
- In This layer a variety functions(tasks) are performed on messages such as:
  1. **File transfer, access, and management (FTAM):** An application layer allows a user to: access the files in a remote computer, retrieve the files from the computer and to manage the files.
  2. **Mail services:** provides the facility for email forwarding and storage.
  3. **Directory services**: provides the distributed database sources which will be used to provide that global information about various objects.
- **DNS** (**Domain Name System**) – **FTP** (**File Transfer Protocol**) – **HTTP** (**Hyper Text Transfer Protocol**), are examples of protocols works within this layer

2) LAYER 6: PRESENTATION Layer

- acts as a data translator (**converts the data from one format to another format**)
- In This layer a variety functions are performed on messages such as:
  1. **Translation:** converts the data formatted by the sender computer to a format could be understood by the receiver computer (for example ASCII to EBCDIC, JPEG file to GIF file, MP3 to MP4)
  2. **Data compression and decompression.**
  3. **Data encryption and decryption** for security purposes**.**
- **XDR** (**External Data Representation**), and **TLS** (**Transport Layer Security**) are examples of protocols operate in this layer

3) LAYER 5: SESSION Layer

- Responsible for managing and synchronizes the interaction between devices.
- In This layer a variety functions are performed on messages such as:
  1. **establishes, manages, and terminates sessions between communicators** (When you open the e-mail here the session is started, and when you write a message or browsing the e-mail here called the managing of the session, and when you sign out of the mail here the session is ended).
  2. **synchronizes dialog between communicators and manages their data exchange (**when they start, period, and when they finished**)**
  3. **monitoring users** (**wither they are authorized to use the network or not**)
  4. **payment bills issues**
- **PPTP** (**Point-to-Point Tunneling Protocol**) and **SAP** (**Session Announcement Protocol**), are examples of protocols works within this layer

4) LAYER 4: TRANSPORT Layer

- **In the sending node** this layer: breaks the message in to **segments** and give each one a number (***Segment ID***) to determined its sequence, the size of each segment is depend on the media used.
- **In the receiving node**: will gathering the segments depending to its ID.
- In This layer a variety functions are performed on messages such as:
  1. **Data Flow control,** when the memory in received node become fill, the node asked the sending node to stop sending data for some time, or decrease the transmission speed
  2. **Error recovery,** this layer in the destination node will send an acknowledgment (positive or negative) to the source node, that the message received without any errors, in the order in which they are sent, and there is no duplication of data
- **TCP** (**Transmission Control Protocol**) and **UDP** (**User Datagram Protocol**), are examples of protocols works within this layer

5) LAYER 3: NETWORK Layer

- manages device addressing, follow the location of devices on the network.
- It determines the best path to move data from source to the destination
- In This layer a variety functions are performed on messages such as:
  1. **Packetizing:** receives segments from upper layer, converts them into **packets,** this process is achieved by **Internet Protocol** (**IP**).
  2. **Routing:** determines the best optimal path out of the multiple paths from source to the destination
  3. **Addressing**: Adds the source and destination address to the header of the frame. Addressing is used to identify the device on the internet.
  4. **Subnet traffic control**: ask the sending device to slow down its frame transmission when the router's buffer fills up.
- **IP** ***(*****Internet Protocol**) (**IPv4 & IPv6**), **IPX** (**Internetwork Packet Exchange**), and **IGMP** (**Internet Group Management Protocol**).

6) LAYER 2: DATA LINK Layer

- Convert the received packet to **frame** by adding some check bits for error-free transfer of data (**CRC** or **FCS** values) and adding the physical (**MAC (Media Access Control)**) address
- In This layer a variety functions are performed on messages such as:
  1. **Frame delimiting**: creates and recognizes **frame** boundaries.
  2. **Media access management**: determines when the node "has the right" to use the physical medium.
  3. **Adds meaningful bits** to the beginning (header) and end(trailer) of the frame **for frame error checking** by using one of the following algorithms:
     Frame Check Sequence (**FCS**) or **Cyclic Redundancy Check** (**CRC**)
  4. add physical address and other control information to the packet
- It consists of two sub layers:
  1. **Logical Link Control (LLC):** manages communications between devices over a single link of a network and transferring the packets to the receiver node.
  2. **Media Access Control (MAC): adding physical address** of destination computer onto the frame

7) LAYER 1: PHYSICAL Layer (Lowest Level)

- In This layer a variety functions are performed on messages such as:
  1. **Convert the frame to a stream of bits** and Manages putting these bits onto the media
  2. **Physical characteristics**, specifies the mechanical, electrical and procedural Physical characteristics of **Network Interface Card (NIC)** and **media** used
  3. **Representation of bits**, modifies the simple digital signal pattern (1s and 0s) used by the PC to better agree with the characteristics of the physical media (determines the type of the signal used for transmitting the information)
  4. **Data Transmission,** It defines the transmission mode whether it is simplex, half-duplex or full-duplex mode between the two devices on the network.
  5. **Topology,** defines the way how network devices are arranged.