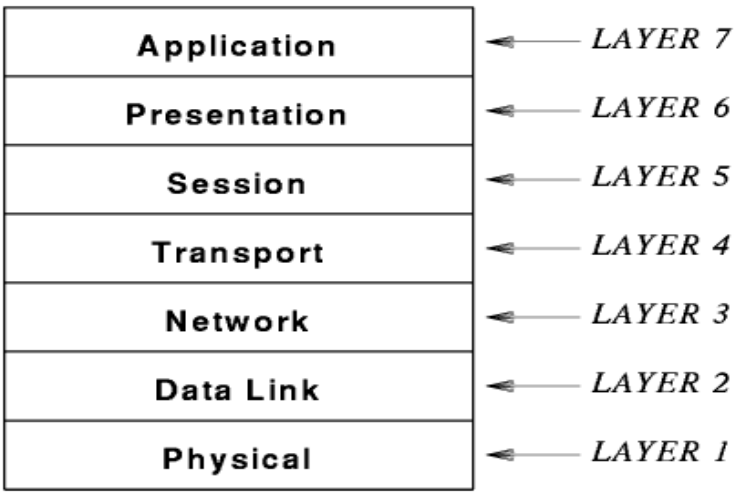
ISO/OSI Model

- The International Standards Organization (ISO) Open Systems Interconnect (OSI) is a standard set of rules describing the transfer of data between each layer in a network operating system. Each layer has a specific function (i.e. the physical layer deals with the electrical and cable specifications)
- The OSI Model clearly defines the interfaces between each layer. This allows different network operating systems and protocols to work together by having each manufacturer adhere to the standard interfaces. The application of the ISO OSI model has allowed the modern networks that exist today. There are seven layers in the OSI model.



The ***Physical Layer***

- Establishes the physical characteristics of the network (e.g., the type of cable, connectors, length of cable, etc.)
- Defines the electrical characteristics of the signals used to transmit the data (e.g. signal voltage swing, duration of voltages, etc.)
- Transmits the binary data (bits) as electrical or optical signals depending on the medium.

The ***Data Link Layer***

- Defines how the signal will be placed on or taken off the NIC. The data frames are broken down into individual bits that can be translated into electric signals and sent over the network. On the receiving side, the bits are reassembled into frames for processing by upper levels.
- Error detection and correction is also performed at the data link layer. If an acknowledgement is expected and not received, the frame will be resent. Corrupt data is also identified at the data link layer.
- Because the Data-Link Layer is very complex, it is sometimes divided into sublayers (as defined by the IEEE 802 model). The lower sublayer provides network access. The upper sublayer is concerned with sending and receiving packets and error checking.

The ***Network Layer***

- Primarily concerned with addressing and routing. Logical addresses (e.g., an IP address) are translated into physical addresses (i.e., the MAC address) for transmission at the network layer. On the receiving side, the translation process is reversed.
- It is at the network layer where the route from the source to destination computer is determined. Routes are determined based on packet addresses and network conditions. Traffic control measures are also implemented at the network layer.

The ***Transport Layer***

- On the sending side, messages are packaged for efficient transmission and assigned a tracking number so they can be reassembled in proper order. On the receiving side, the packets are reassembled, checked for errors and acknowledged.
- Performs error handling in that it ensures all data is received in the proper sequence and without errors. If there are errors, the data is retransmitted.

The ***Session Layer***

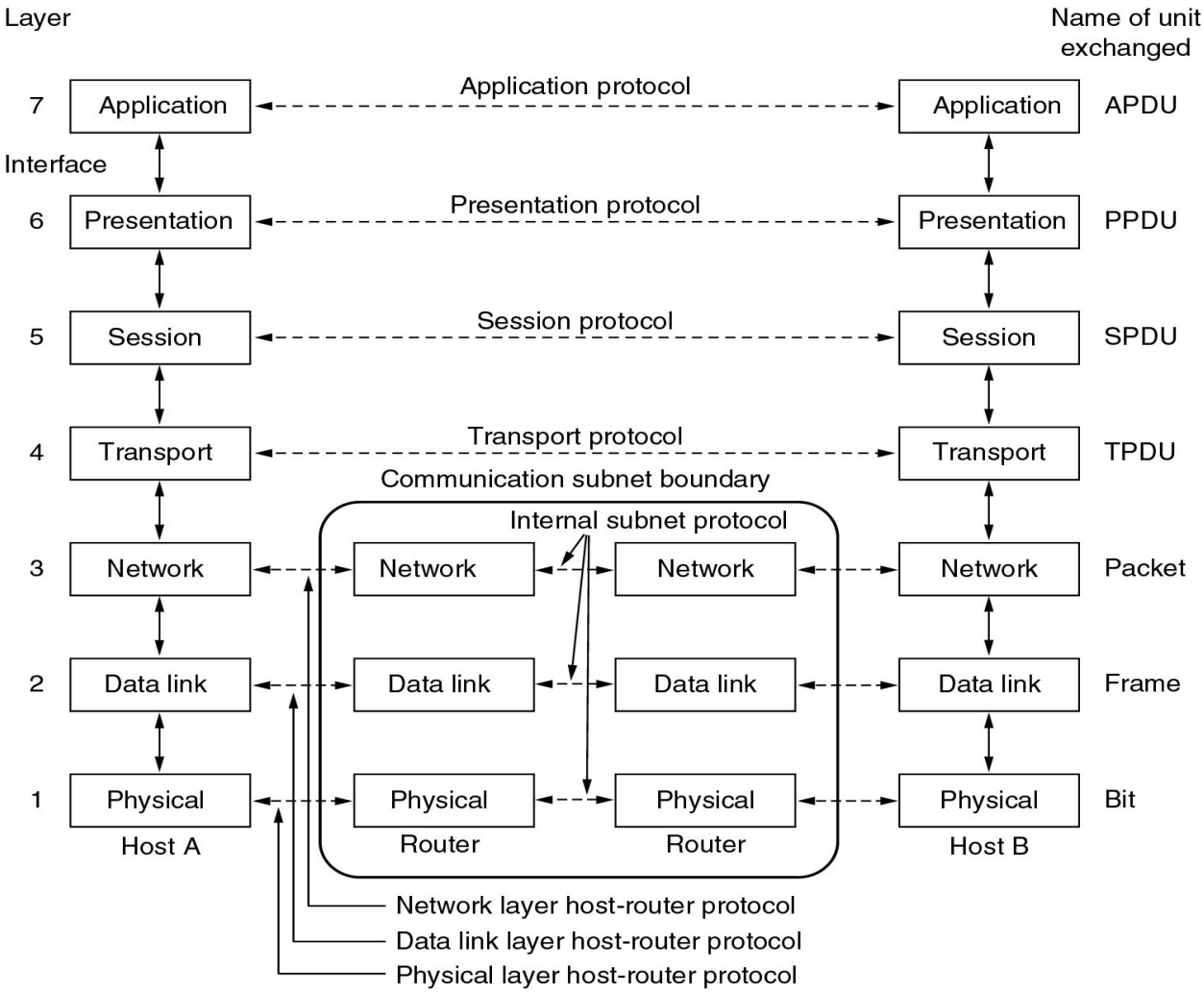
- Is responsible for establishing, maintaining, and terminating a connection called a 'session'.
- A session is an exchange of messages between computers (a dialog). Managing the session involves synchronization of user tasks and dialog control (e.g., who transmits and for how long). Synchronization involves the use of checkpoints in the data stream. In the event of a failure, only the data from the last checkpoint has to be resent.
- Logon, name recognition and security functions take place at the Session Layer.

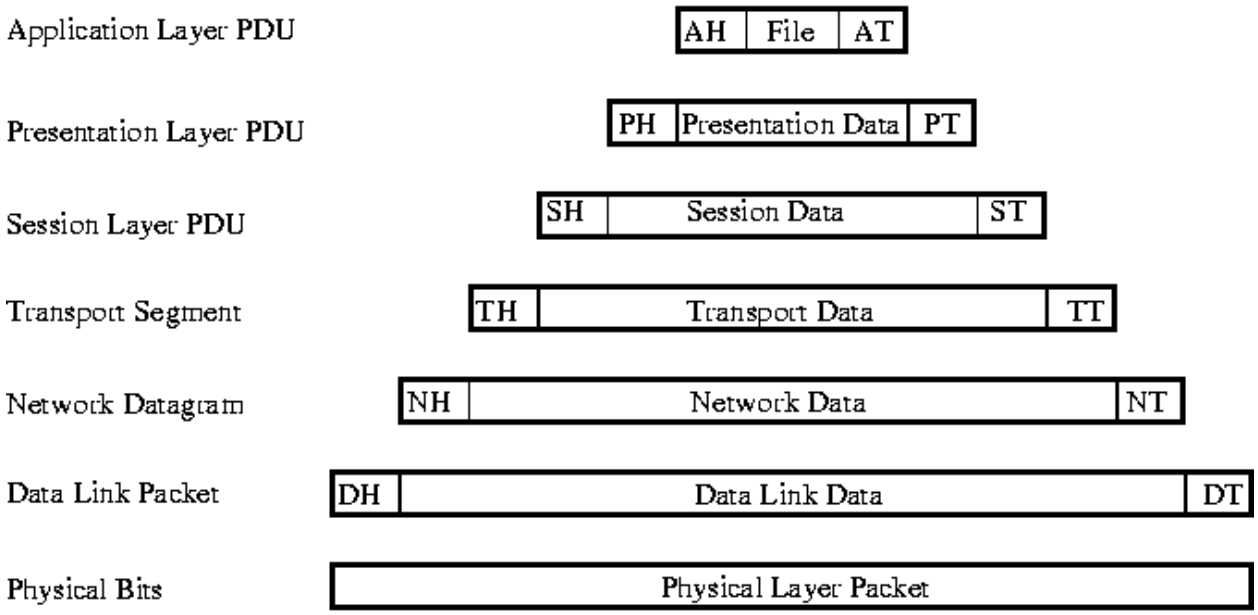
The ***Presentation Layer***

- It is responsible for data translation (formatting), compression, and encryption.
- The Presentation Layer is primarily concerned with translation; interpreting and converting the data from various formats. For example, EBCIDIC characters might be converted into ASCII. It is also where data is compressed for transmission and uncompressed on receipt. Encryption techniques are implemented at the Presentation Layer.
- The redirector operates at the presentation layer by redirecting I/O operations across the network.

The ***Application Layer***

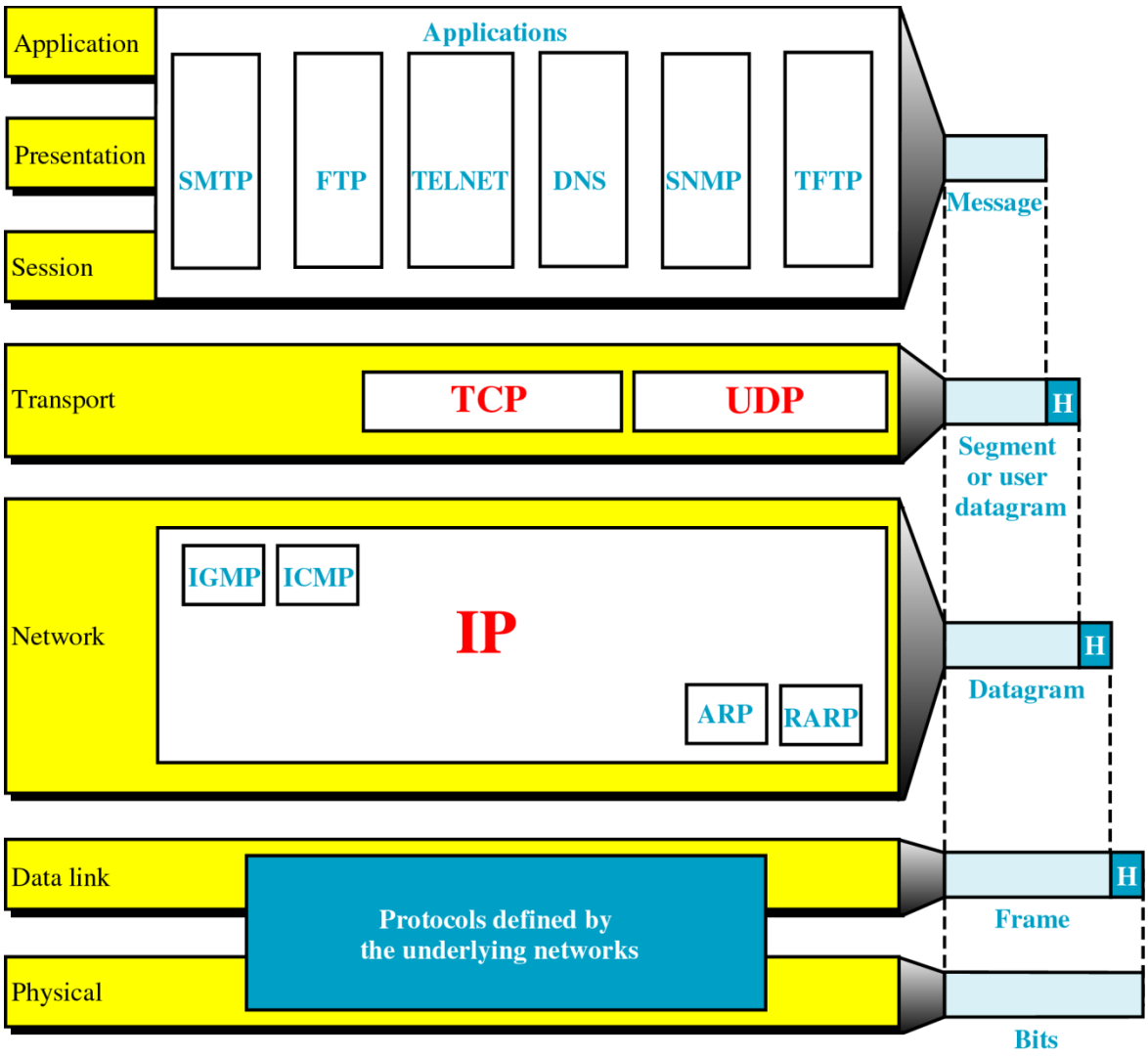
- Provides the operating system with direct access to network services.
- It serves as the interface between the user and the network by providing services that directly support user applications.


Layer
Name of unit exchanged
7
Application
Application protocol
Application
APDU
Interface
6
Presentation
Presentation protocol
Presentation
PPDU
5
Session
Session protocol
Session
SPDU
4
Transport
Transport protocol
Transport
TPDU
Communication subnet boundary
Internal subnet protocol
3
Network
Network
Network
Network
Packet
2
Data link
Data link
Data link
Data link
Frame
1
Physical
Physical
Physical
Physical
Bit
Host A
Router
Router
Host B
Network layer host-router protocol
Data link layer host-router protocol
Physical layer host-router protocol



Each layer may add a Header and a Trailer to its Data (which consists of the next higher layer's Header, Trailer and Data as it moves through the layers). The Headers contain information that specifically addresses layer-to-layer communication. For example, the Transport Header (TH) contains information that only the Transport layer sees. All other layers below the Transport layer pass the Transport Header as part of their Data.

OSI vs. TCP/IP


Application
Presentation
Session
Applications
SMTP
FTP
TELNET
DNS
SNMP
TFTP
Message
Transport
TCP
UDP
H
Segment
or user
datagram
Network
IGMP
ICMP
IP
ARP
RARP
H
Datagram
Data link
Protocols defined by
the underlying networks
H
Frame
Physical
Bits