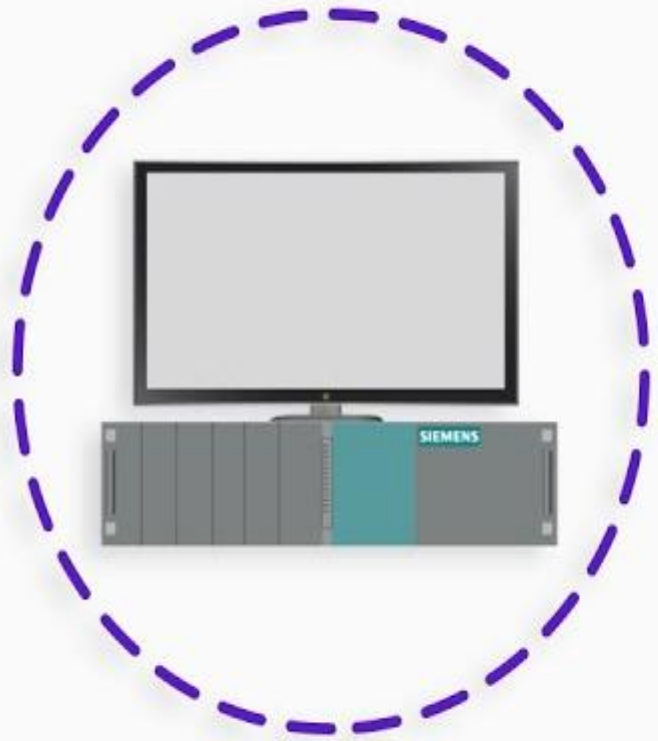
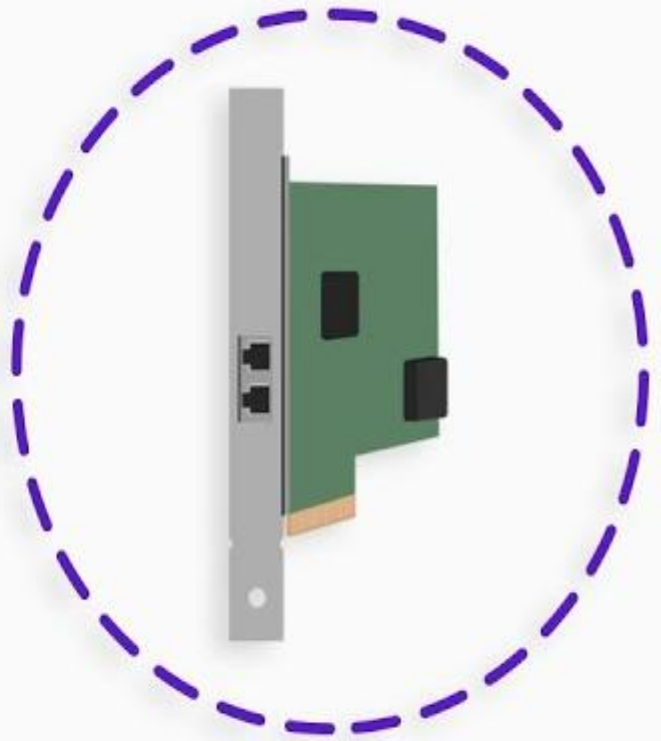
OSI Model



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



OSI Model Layers and its Functions

- The Open System Interconnection (OSI) reference model is an industry-standard framework created and maintained by the International Standardization Organization (ISO). The OSI model was created to make network devices and network protocols interoperable.
- It allows components, such as hard drives and video cards, to function in a computer or network independent of the manufacturers. In networking, the OSI model defines how media, protocols, and standards work together.

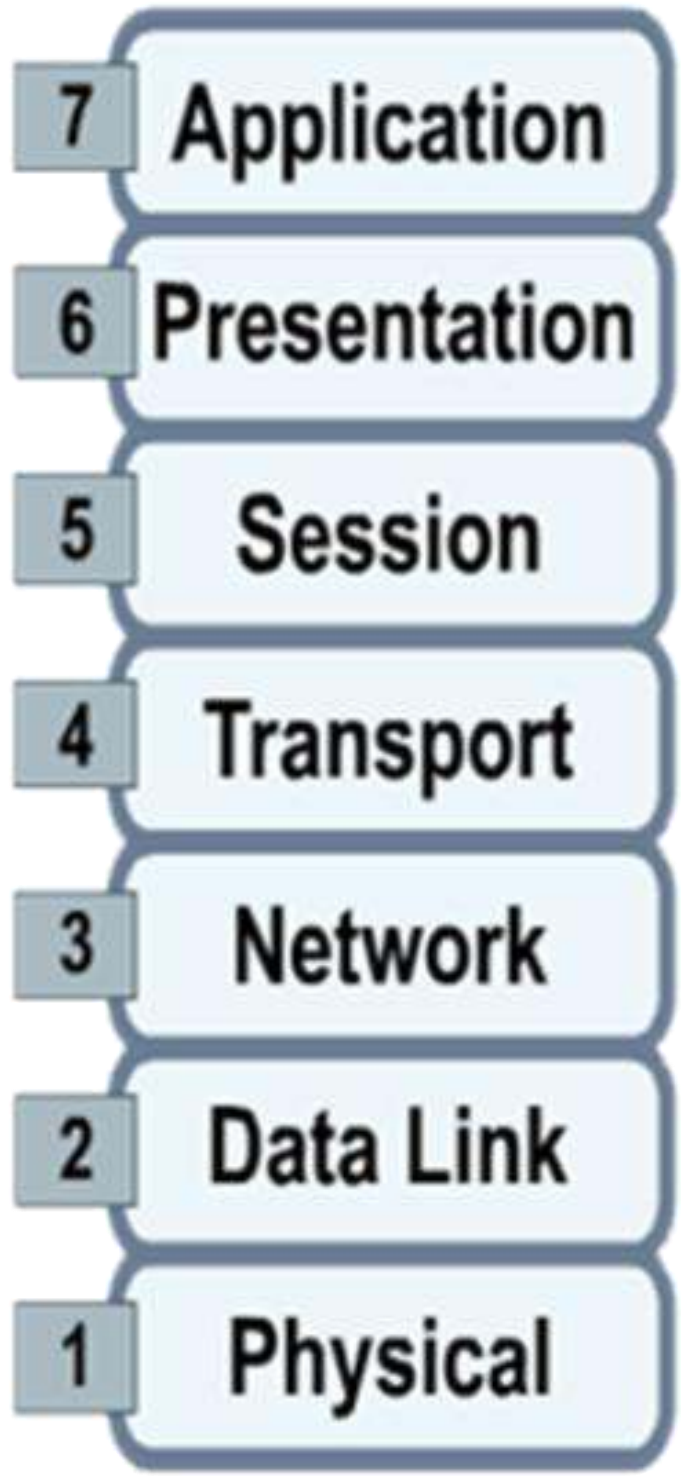
OSI Model

Data	Layers	
	Host Layers	
Data		Application Network Process to Application
Data		Presentation Data Representation & Encryption
Data		Session Inter-Host Communication
Segments		Transport End-to-End Connections & Reliability
	Media Layers	
Packets		Network Path Determination & IP
Frames		Data Link MAC & LLC (Physical Addressing)
Bits		Physical Media,Signal,& Binary Transmission

Benefits of the OSI Model

- Divides the aspects of network operations into less complex components.
- Standardizes interfaces, enabling engineers to specialize design and development efforts to specific functions.
- Facilitates modular engineering and prevents changes in one area from affecting others.
- Ensures interoperability and allows network designers to choose the right networking devices.
- Accelerates evolution and helps with testing and troubleshooting the network.

Seven Layers of the OSI Model



Physical Layer – Layer 1

- The physical layer is responsible for converting bits from a computer, represented by zeros and ones, into a signal that can be sent over the network. Signals are propagated over some media: twisted-pair cable, fiber optic cable, coaxial cable, or air.
- The physical layer provides the electrical, mechanical, procedural, and functional means for implementing physical media for the purposes of propagating data via signaling.
- Common layer 1 devices include repeaters and hubs. These are considered “dumb” devices because they do not make any decisions about what they are receiving or sending.

Data Link Layer – Layer 2

- The data link layer is responsible for supporting all network protocols that need to propagate over the physical media.
- Layer 2 is also responsible for the speed of transmission, flow control, and error correction. The data link layer uses the physical topology to identify the devices and the media comprising the network.
- The primary layer 2 networking devices are bridges and switches; these devices have some “intelligence” in that they make decisions about forwarding protocol data units (PDUs).
- Bridges are legacy devices, meaning that they are rarely used in modern networks. Switches have replaced bridges because switches are faster, have more ports, and support more technologies.

The data link layer can be divided into two sublayers:

- **Logic link control (LLC) – responsible for frame synchronization, flow control, and error checking along with identifying protocols like Ethernet or 802.3.**
- **Media access control (MAC) – the interface between the LLC and the physical layer, responsible for delimiting layer 2 PDUs, or frames.**

Network Layer – Layer 3

- **OSI layer 3 is the network layer. This is where most of the action takes place in the day-to-day work of networking professionals. The Internet exists largely because of the Internet Protocol (IP), a layer 3 protocol.**
- **Historically, many layer 3 protocols were used for network implementations; but over time IP became the exclusive network layer protocol, so we often make the immediate association of IP with layer 3.**
- **There are two fundamental implementations of IP: IP version 4 and IP version 6, with IPv6 slowly but surely replacing IPv4. The term packet, or datagram, is often used when referring to network layer PDUs, like IP packets.**
- **The network layer is responsible for end-to-end path determination. Layer 3 network design ensures that every IP address is unique. IPv4 addresses and IPv6 addresses are two examples of network addresses or logical addresses.**

Network Layer – Layer 3

- A network has both a physical and a logical topology; the logical topology is associated with the network layer, and layer 3 addressing provides the hierarchical labeling scheme for the logical topology.
- A subnet is a network that combines with other networks to form a larger network.
- The networking device most often associated with layer 3 is a router. Routers interconnect to form the skeleton of the Internet. Routers define the networks that comprise the Internet. Routers forward IP packets through the Internet.

Transport Layer – Layer 4

- **The transport layer is responsible for segmenting application data, regulating the flow of information, and enhance the quality of service (QoS) minimally provided by the network layer.**
- **While the network layer is dedicated to moving data between remote networks, the transport layer instantiates and maintains the communication session specific to an application or service on the two hosts at each end of the session.**
- **The term segment is often used to describe transport layer PDUs; for example, TCP segments and UDP segments are encapsulated by IP packets.**

Transport Layer – Layer 4

- **Transport control protocol (TCP)** – connection-oriented protocol with built-in reliability mechanisms that guarantee delivery of data between source and destination in virtual circuits, based on prescriptive operations: sliding windows and sequencing and acknowledgment of data segments.
- **User datagram protocol (UDP)** – a connectionless protocol that sends data without guaranteeing delivery or acknowledging its receipt. UDP is used with voice and video traffic, and other types of traffic where it is not as important to verify the arrival and order of data comprising a communication session. UDP is often the transport layer protocol of choice when speed is more important than reliability.

Session Layer – Layer 5

- **The session layer is responsible for establishing, maintaining, and terminating sessions between two computers. This includes starting, stopping, and re-synchronizing two computers as they communicate, a process called session control.**
- **A keyword to remember for layer 5 is *communication*. The session's characteristic of layer 5 are analogous to TCP virtual circuits, but involve more administrative overhead in order to provide greater functionality.**
- **The data link layer services the network layer. The network layer services the transport layer. The transport layer services the session layer. The session layer services the presentation layer, which we explore next.**

Presentation Layer – Layer 6

- **The presentation layer facilitates communication between applications on distinct computer systems in such a way that the mechanics of the facilitation are transparent to the applications. Layer 6 is responsible for three main functions:**

  - **encryption/decryption**
  - **compression/decompression**
  - **the syntax which defines the communication, such as JPEG for graphics, TXT for text files, MP3 for audio files; all devices communicating must be able to speak the same language to interact.**

Application Layer – Layer 7

- The application layer is the layer nearest to the user and provides services to applications used by the endpoint devices. It does not provide services to any other OSI layer.

The World Wide Web (WWW) is a system realized at the application layer of the OSI model.

- The application layer is most often associated with services and applications such as Telnet, SSH, FTP, HTTP, HTTPS, and email (SMTP, POP, IMAP).

Encapsulation

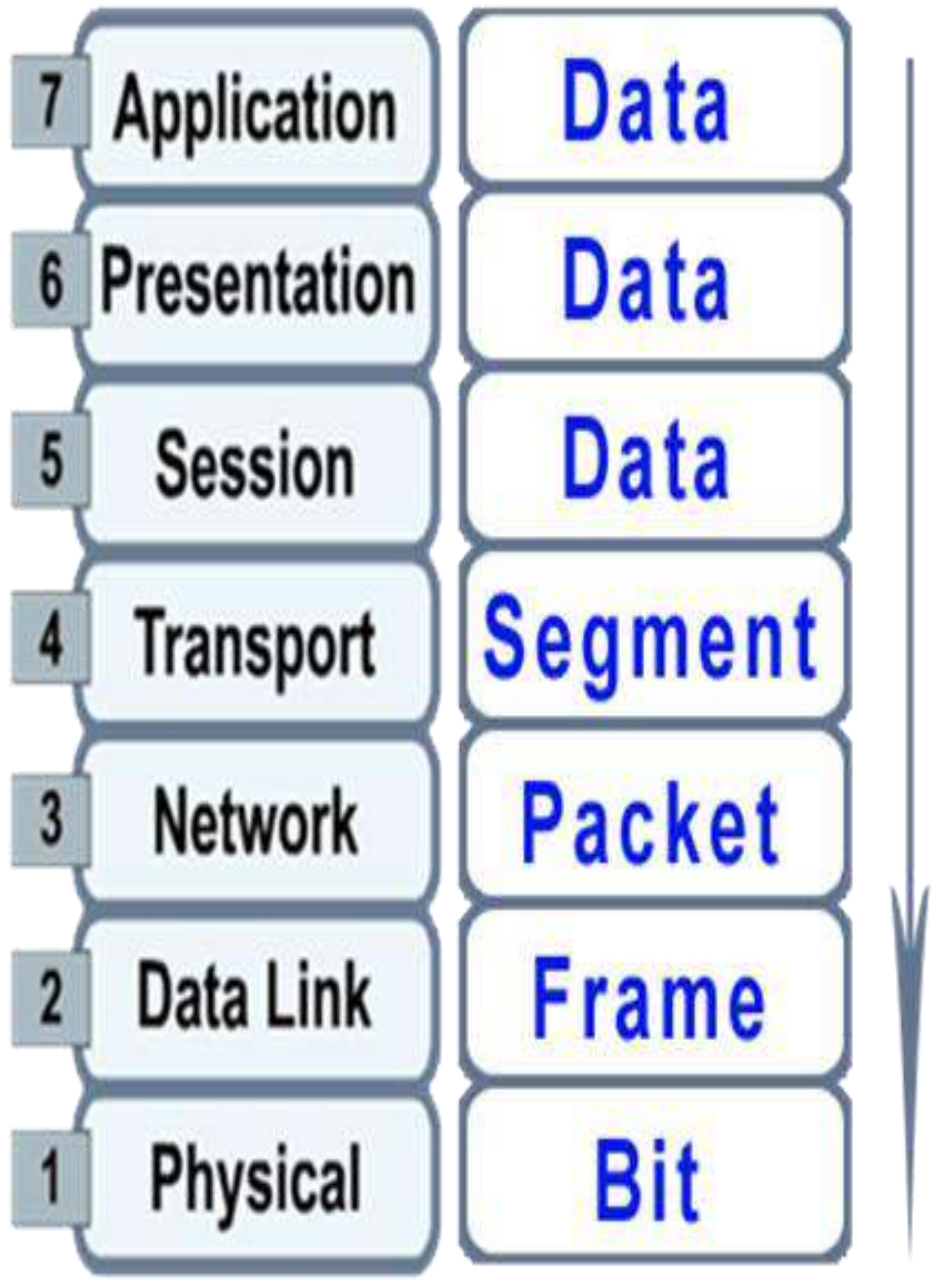
- ***Encapsulation** is the process of placing one PDU inside another PDU for network delivery.*

- **As data moves down the OSI layers, PDUs are recursively encapsulated in PDUs associated with the respective layers. At each stage of encapsulation, headers and footers are pretended and appended to the respective PDU to create a new PDU.**

- **The process can be described in five steps, using the PDU terminology we have adopted:**

Encapsulation

- **Data – Data consists of strings of alphanumeric characters used by a computer system application.**
- **Segments – The data is packaged into segments for end-to-end transport. By using segments, the transport layer ensures that the message hosts at both ends of, say, an email system can reliably communicate.**
- **Packets – The segments are encapsulated within packets, or datagrams, that include network headers with source and destination logical addresses (usually IPv4 or IPv6).**



Encapsulation

- **Frames – The frames traverse a one-hop singular path directly connecting one network device to another network device; the hop is one link of a chain of links comprising an end-to-end network communication instance. The frame header includes the source and destination physical addresses required for data link layer communication.**

- **Bits – The binary (electrical or optical) information sent over a medium as signals.**