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Open Systems Interconnections (OSI) Model

Layer 1 : Physical Layer

The physical layer is the lowest layer of the OSI model and it is responsible for the actual transmission of raw bits over a physical communication medium. It defines the mechanical, electrical, and procedural characteristics of the network, including cable types, connectors, pin layouts, voltage levels, signal timing, data rates, and modulation techniques. This layer determines how binary data (0s and 1s) are represented as electrical signals, light pulses, or radio waves, and it specifies whether communication is simplex, half-duplex, or full-duplex. Devices such as cables, hubs, repeaters, network interface cards, and physical network topologies operate at the physical layer.

In addition to signal transmission, the physical layer ensure proper synchronization between sending and receiving devices so that bits are correctly interpreted. It handles issues such as bit rate control, physical addressing through hardware interface and transmission mode, but it does not understand or interprete the data itself. By providing a standardized way to move raw data across different physical media, the physical layer forms the foundation upon which all higher OSI layers build reliable and meaningful network communication.

Layer 2 : Data Link Layer

The data link layer is responsible for reliable data transfer between directly connected network nodes. It packages raw bits from the physical layer into frames, adds physical (MAC) address to identify source and destination devices, and controls access to the shared ~~medium~~ transmission medium. This layer also performs error detection using techniques such as frame checksums or cyclic redundancy checks (CRC), allowing the receiving device to detect corrupted frames. Common technologies operating at the data link layer include Ethernet, WI-FI (IEEE 802.11), and switches, which use MAC address to foward frames within a local network.

In addition, the data link layer manages flow control to prevent a fast sender from overwhelming a slower receiver and may handle error correction through transmission mechanisms in some protocols. It is often divided into two sublayers :

• The Logical Link Control (LLC), which provides an interface to the network layer and manages protocol multiplexing, and the ~~Media acce~~
• The Media Access Control (MAC), which governs how devices share and access the physical medium. By ensuring organized, error-checked, and orderly frame delivery across a single network segment, the data link layer provides a dependable link between the physical and network layers.

Layer 3 : Network Layer

The network layer is responsible for delivering the data packets from a source device to a destination device across multiple interconnected networks. Its primary functions include logical addressing, routing, and path selection, allowing data to traverse different network segments and technologies. This layer encapsulates data into packets, assigns source and destination logical addresses such as IP addresses, and determines the best available route through the network, ~~thing~~ using routing algorithms and routing tables. Routers and layer-3 switches operate at this layer, making forwarding decisions based on network-layer information rather than physical addressing.

In addition to routing, the network layer handles packet fragmentation and reassembly when packets must pass through networks with different maximum transmission units (MTUs), ensuring compatibility across diverse links. It may also support basic error handling and congestion control, although reliable delivery is typically left to higher layers. By abstracting the underlying physical network structure and providing end-to-end logical addressing and routing, the network layer enables scalable, flexible communication between devices located on different networks.

Layer 4 : Transport Layer

The transport layer is the fourth layer of the OSI model and is responsible for providing end-to-end communication services between applications running on different hosts. It ensures that data is delivered from the source application to the correct destination application using port numbers, which allow multiple applications to share the same network connection. This layer handles segmentation of large data streams into smaller units, reassembly at the destination, and may provide reliable data transfer through error detection, acknowledgments, and retransmission of lost segments, as seen in protocols like TCP, while also supporting connectionless, best-effort delivery through protocols like UDP.

Additionally, the transport layer manages flow control to prevent a sender from overwhelming a receiver and may implement congestion control to adjust transmission rates based on network conditions. It establishes, maintains, and terminates logical connections between endpoints when required, ensuring orderly communication sessions. By abstracting network details from applications and providing reliable or efficient data transport services as needed, the transport layer plays a critical role in enabling consistent and effective end-to-end communication across complex networks.

Layer 5 : Session Layer

The session layer is the fifth layer of the OSI model and is responsible for establishing, managing, and terminating communication sessions between applications on different systems. It controls the dialogue between communicating devices by determining who can transmit data and when, and whether communication occurs in half-duplex or full-duplex mode. This layer also provides session synchronization through the use of checkpoints, which allow communication to resume from a known state in the event of a failure rather than restarting the entire data transfer.

In addition, the session layer handles session recovery and management tasks such as authentication, authorization, and session maintenance in some implementations. Although its functions are often integrated into the application or transport layers in modern networking protocols, the session layer conceptually ensures organized, coordinated, and recoverable exchanges of data. By managing sessions independently of the underlying transport mechanisms, it supports structured and reliable interactions between networked applications.

Layer 6 : Presentation Layer

The presentation layer is the sixth layer of the OSI model and is responsible for translating data between the application layer and the lower network layers so that information is presented in a usable and standardized format. It handles data representation task such as character encoding (for example, ASCII or Unicode), data format conversion, and serialization, ensuring that systems with different internal data structures can communicate correctly.

This layer also manages data compression to reduce the amount of data transmitted and improve efficiency.

In addition, the presentation layer is responsible for data encryption and decryption, providing confidentiality and security during transmission. By tranforming encoding, and securing data befor it is sent and reversing the process upon reception, the presentation layer ensures that the receiving application can correctly interpret the data. Although many ~~moderer~~ modern protocols integrate these functions into the ~~reception~~ application layer, the presentation layer remains a key conceptual component for understanding how data is formatted, compressed, and protected in network communication.

Layer 7 : Application Layer

The application layer is the seventh layer of the OSI model and it provides network services directly to end-user applications. It serves as the interface between the users software and the underlying network, enabling applications to request and receive network services such as file transfer, email, remote ~~door~~ access, and web browsing. This layer defines the protocols and rules that applications use to communicate over a network, including well known protocols such as HTTP, HTTPS, FTP, SMTP, POP3, IMAP, and DNS.

In addition to facilitating communication, the application layer handles functions such as user authentication, resource availability, and service advertisement. It does not provide services to other OSI layers but instead focuses on supporting application level interactions and data exchange. By abstracting complex network operations and presenting them as accessible services, the application layer enables seamless interaction between users and networked systems, making it a crucial component of modern network communication.