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What is the OSI Model? Explore the 7 Layers of the Open Systems Interconnection Model



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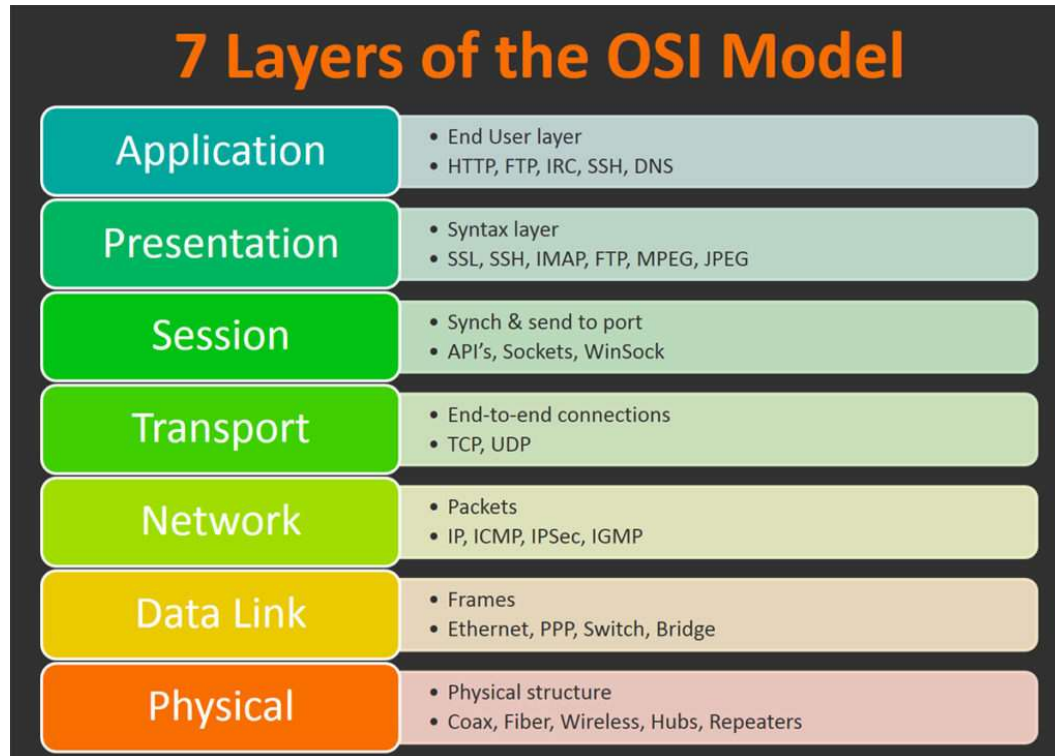
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The Open Systems Interconnection (OSI) Reference Model is a **conceptual framework** that describes functions of the networking or telecommunication system independently from the underlying technology infrastructure. It divides data communication into seven abstraction layers and standardizes protocols into appropriate groups of networking functionality to ensure interoperability within the communication system regardless of the technology type, vendor and model. The OSI model was originally developed to facilitate interoperability between vendors and to define clear standards for network communication. However, the older **TCP/IP model** remains the ubiquitous reference framework for Internet communications today.

Here we briefly explore the seven layers of the OSI model:

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



The lowest layer of the OSI model concerns with the data communication in the form of electrical, optic or electromagnetic signals physically transmitting information between networking devices and infrastructure. The **Physical Layer** is essentially responsible for the communication of unstructured raw data streams over a physical medium. It defines a range of aspects associated with the electrical, mechanical and physical systems and networking devices that include the specifications; e.g. cable size, signal frequency, voltages, etc.; **topologies** such as Bus, Star, Ring and Mesh; **communication modes** such as Simplex, Half Duplex and Full Duplex; data Transmission Performance e.g. **Bit Rate** and **Bit Synchronization**; as well as modulation, switching and interfacing with the physical transmission medium as described [here](#). Common protocols include Wi-Fi, Ethernet and others as listed [here](#). The hardware includes networking devices, antennas, cables, modem, intermediate devices such as repeaters and hubs.

2.Data Link Layer

The second layer of the OSI model concerns with data transmission between the nodes within a network and manages the connections between physically connected devices such as switches. The raw data received from the physical layer is synchronized and packaged into data **frames** that contain the necessary protocols to route information between appropriate nodes. The **Data Link Layer** is further divided into two sublayers: Logical Link Control (LLC) sublayer responsible for **flow controls** and **error controls** that ensure error-free and accurate data transmission between the network nodes; and the Media Access Control (MAC) sublayer responsible for managing access and permissions to transmit data between the network nodes. The data is transmitted sequentially and the layer expects acknowledgement for the encapsulated raw data sent between the nodes.

3.Network Layer

The third layer of the OSI model organizes and transmits data between multiple networks. The layer is responsible for routing the data via the best physical path based on a range of factors including network characteristics, best available path, **traffic controls**, congestion of data packets and priority of service, among others. The network layer implements logical addressing for data packets to distinguish between the source and destination networks. Other functions at the Network Layer include **encapsulation and fragmentation**, as well as congestion

controls and error handling. The outgoing data is divided into packets and incoming data is reassembled into information that is consumable at a higher application level. Network Layer hardware includes routes, bridge routers, 3-

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layer switches and protocols such as Internet (IPv4) Protocol version 4 and Internet Protocol version 6 (IPv6).

4.Transport Layer

The fourth layer of the OSI model ensures complete and reliable delivery of data packets. The **Transport Layer** provides mechanisms such as error control, flow control and congestion control to keep track of the data packets, check for errors and duplication, and resend the information that fails delivery. It involves the service-point addressing function to ensure that the packet is sent in response to a specific process (via a port address). **Packet Segmentation** and reassembly ensure that the data is divided and sequentially sent to the destination where it is rechecked for integrity and accuracy based on the receiving sequence. Common protocols include the **Transmission Control Protocol (TCP)** for connection-oriented data transmission and **User Datagram Protocol (UDP)** for connectionless data transmission.

5.Session Layer

The **Session Layer** manages sessions between servers to coordinate the communication – as the first of the top three OSI model layers that deal with the software level. Session refers to any interactive data exchange between two entities within a network. Common examples include HTTPS sessions that allow Internet users to visit and browse websites for a specific time period. The Session Layer is responsible for a range of functions including opening, closing and re-establishing session activities, authentication and authorization of communication between specific apps and servers, identifying full-duplex or half-duplex operations and synchronizing data streams. Common Session Layer protocols include Remote procedure call protocol (RPC), Point-to-Point Tunneling Protocol (PPTP), Session Control Protocol (SCP) and Session Description Protocol (SDP) as described [here](#).

6.Presentation Layer

The fifth layer of the OSI model converts data formats between applications and the networks. Responsibilities of the **Presentation Layer** include **data conversion**, **character code translation**, **data compression**, **encryption and decryption**. The Presentation Layer, also called the Syntax Layer, maps the semantics and syntax of the data such that the received information is consumable for every distinct

network entity. For example, the data we transfer from our encryption-based communication app is formatted and encrypted at this layer before it is sent across the network. At the receiving end, the data is decrypted and formatted

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into text or media information as originally intended. The presentation layer also serializes complex information into transportable formats. The data streams are then deserialized and reassembled into original object format at the destination.

7.Application Layer

The **Application Layer** concerns with the networking processes at the application level. This layer interacts directly with end-users to provide support for email, network data sharing, file transfers and directory services, among other distributed information services. The upper most layer of the OSI model identifies networking entities to facilitate networking requests by end-user requests, determines resource availability, synchronizes communication and manages application-specific networking requirements. The Application Layer also identifies constraints at the application level such as those associated with authentication, privacy, quality of service, networking devices and data syntax. The most common **Application Layer protocols** include File Transfer Protocol (FTP), Simple Mail Transfer Protocol (SMTP) and Domain Name System (DNS).

The Internet Doesn't Welcome OSI!

The OSI model is widely criticized for its inherent implementation complexity that render networking operations as inefficient and slow. The academic approach to developing the OSI protocol suite relied on replacing existing protocols across all communication layers with better alternatives. This approach failed to gain traction in the industry as vendors had already invested significant resources in TCP/IP products and had to manage interoperability with the vast choices of protocols and specifications offered by the OSI model. Additionally, the academia itself considered the OSI model as an invention politically inspired by the European telecommunication and U.S. government authorities.

The older TCP/IP architecture model had already proven to work well in real-world network environments. It served as a solid foundation for the Internet – including all of the security, privacy and performance related challenges. Continued research and development, investments and industry-wide adoption of the OSI model could have made today's cyber world a different (and even a better) place. But what was the pragmaticism with the TCP/IP model and not the aspiration toward perfectionism with the OSI model that gave us the Internet that prevailed today.

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