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The **Open Systems Interconnection (OSI) Reference Model**, developed by the International Standards Organization (ISO), is a conceptual framework that standardizes communication in computer networks. It divides communication into **seven layers**, each with specific responsibilities, and uses **protocol data units (PDUs)** to represent the information being processed at each layer. This layered design promotes interoperability, modularity, and ease of troubleshooting (Stallings, 2014).

The Seven Layers

1. **Physical Layer**
   This is the lowest layer of the OSI model, responsible for the actual transmission of raw binary data (0s and 1s) across a medium such as copper wire, fiber optics, or radio waves. It defines voltages, pin layouts, modulation techniques, and timing. The **PDU is Bits**. Without this layer, no physical connectivity could exist between devices (Tanenbaum, 2011).

2. **Data Link Layer**
   The Data Link layer ensures reliable node-to-node transfer by grouping raw bits into structured units called **frames**. It performs error detection, correction, and flow control. It is further divided into the **MAC (Media Access Control)** sublayer, which controls access to the transmission medium, and the **LLC (Logical Link Control)** sublayer, which manages frame synchronization. The **PDU is Frames** (Stallings, 2014).

3. **Network Layer**
   This layer is concerned with delivering data across multiple networks. It manages logical addressing (such as IP addresses) and determines the best path for data through routing. It breaks transport layer segments into **packets**. Protocols like IP and ICMP operate here. The **PDU is Packets** (Kurose & Ross, 2017).

4. **Transport Layer**
   The Transport layer provides reliable, transparent transfer of data between end systems. It ensures error recovery, sequencing, and flow control. TCP provides connection-oriented service with reliability, while UDP provides connectionless, faster delivery. Data at this layer is broken down into **segments**, making the **PDU Segments** (Odom, 2020).

5. **Session Layer**
   The Session layer manages and controls the dialog between applications. It establishes, maintains, and terminates sessions, ensuring proper communication states. It adds synchronization points in long transmissions. The **PDU is Data**, but specifically representing sessions (Tanenbaum, 2011).

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6. **Presentation Layer**
   This layer ensures that data sent by the application layer of one system can be understood by the application layer of another. It translates between different data formats, encrypts for security, and compresses to save bandwidth. Its **PDU is Data**, prepared for interpretation (Kurose & Ross, 2017).

7. **Application Layer**
   The topmost layer provides network services directly to users and applications. Examples include HTTP for web browsing, SMTP for email, and FTP for file transfers. Here, the data is ready for direct user interaction. The **PDU is Data** (Odom, 2020).

Encapsulation and Decapsulation

Data passes from the Application layer down to the Physical layer, undergoing **encapsulation** as headers and trailers are added. Thus, Data becomes Segments, then Packets, then Frames, and finally Bits. At the destination, the reverse process, **decapsulation**, removes these headers until the original data is delivered.

Note:

Encapsulation is the process of adding protocol-specific headers to data as it moves through the layers of the OSI or TCP/IP model.

Decapsulation is the process of removing headers and trailers from data packets as they traverse through the layers of the OSI or TCP/IP model at the receiver's side.

Importance of the OSI Model

The OSI model does not define actual protocols but serves as a reference for designing and understanding networks. It simplifies communication by dividing complex processes into smaller layers, making networking easier to standardize, teach, and troubleshoot (Stallings, 2014).

References

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