Network protocol & Physical layers

Tuesday, December 24, 2024 1:36 PM

1. Definition of NETWORK PROTOCOL:
- **Define communication rules and data formatted** (headers & data).
- Network protocol ENSURES devices in computer network including servers, routers, devices, … can communicate with each other even they are differences.
- **Higher** layers handle **applications & software** while the **lower** layers handle **data transport**.
- **A set of many network protocols that work together is called a protocol suite.**
- Nowadays, the most popular of protocol suite is the **TCP/IP.**

2. The TCP (Tranmission Control Protocol)/IP (Internet Protocol) Layered Architecture Model:
- **Application**: Represents data to the user, plus encoding & dialog control.
  - **Mission:** User-friendly data exchange.
  - **Key words: Data, User, Interaction**
- **Transport**: Supports communication between diverse devices across diverse networks.
  - **Mission:** Reliable data delivery.
  - **Key words: Communication, Reliable, Devices, Networks**
- **Internet**: Determines the best path through the network.
  - **Mission:** Efficient data routing.
  - **Key words: Path, Best, Network**
- **Network**: Controls the hardware devices and media that make up the network.
  - **Mission:** Physical network management.
  - **Key words: Hardware, Media, Control**

3. Benefits of Using a Layered Model:
- Assissts in Protocol design
- Open standard - fosters competition
- Changes made in one layer do not affect other layers.
- Common standard language
- Allows Protocols and technologies to envolve.

4. Data Encapculation (PDUs - Protocol Data Units):
- Data
- Segment
- Packet
- Frame
- Bits
- A PDU is a chunk of data at a specific layer of the OSI model. Each layer has its own type of PDU:
  - **Application Layer:** Data
  - **Presentation Layer:** Data
  - **Session Layer:** Data
  - **Transport Layer:** Segments or User Datagrams
  - **Network Layer:** Packets
  - **Data Link Layer:** Frames
  - **Physical Layer:** Bits
- Imagine you're sending a message to a friend. The original message is the "data" at the Application Layer. As it moves down the layers:
  1. **Transport Layer:** The message is divided into smaller segments (PDUs at this layer) and headers are added with information like the destination port.
  2. **Network Layer:** Each segment is encapsulated into a packet (PDU at this layer) with headers containing IP addresses.
  3. **Data Link Layer:** Each packet is encapsulated into a frame (PDU at this layer) with headers containing MAC addresses.
  4. **Physical Layer:** The frames are converted into bits (PDUs at this layer) for transmission over the physical medium.

=> Data encapsulation is the process of adding headers to data as it moves down the OSI model, transforming it into different PDUs at each layer. This layered approach ensures that data is correctly formatted and routed at each stage of its journey across the network.

5. Reference Model (Mô hìnhnh tham khảo):
- **What they are:** Conceptual frameworks that provide a standardized way to understand and describe the functions involved in network communication.
- **Focus:** Conceptual framework. They break down the complex process of network communication into smaller, more manageable layers, each with specific responsibilities.
- **Example:** The OSI (Open Systems Interconnection) model is a well-known reference model.
- **Differences** between **PROTOCOL and REFERENCE** model:
  - **Purpose**: Protocols are about how to *do* something (actual communication), while reference models are about *understanding* how communication works.
  - **Level of Detail:** Protocols are very specific and detailed, outlining precise rules and formats. Reference models are more abstract and provide a high-level overview of the communication process.
  - **Implementation:** Protocols are implemented in software and hardware. Reference models are conceptual and don't have a direct implementation.

6. The OSI Model (Optional) (Mô hình OSInh OSI)

Mô hình OSI tiêu chuẩn gồm 7 lớp:
- **Lớp vật lý (Physical layer)**: Chịu trách nhiệm truyền dữ liệu dưới dạng tín hiệu vật lý trên kênh truyền.
- **Lớp liên kết dữ liệu (Data link layer)**: Đảm bảo việc truyền dữ liệu giữa các thiết bị trên cùng một mạng.
- **Lớp mạng (Network layer)**: Chịu trách nhiệm định tuyến dữ liệu giữa các mạng khác nhau.
- **Lớp vận chuyển (Transport layer)**: Đảm bảo tính toàn vẹn và độ tin cậy của dữ liệu.
- **Lớp phiên (Session layer):** Quản lý việc khởi tạo, duy trì và kết thúc phiên truyền dữ liệu.
- **Lớp trình bày (Presentation layer)**: Chuyển đổi dữ liệu giữa các định dạng khác nhau.

- **Lớp ứng dụng (Application layer)**: Cung cấp các dịch vụ giao tiếp cho các ứng dụng của người dùng.

7. Comparing the OSI and TCP/IP Model:
   - While the TCP/IP model has 4 layers, the OSI model has 7 layers (Application, Presentation, Session, Transport, Network, Data Link, Physical).

8. The PHYSICAL LAYER (Tầng vậy lí/ Tầng thiết bị/ Tầng vật thểng vậy lí/ Tầng thiết bị/ Tầng vật thể):
   - The physical layer is the lowest layer of the OSI model. It is responsible for the transmission of raw bits over a physical medium, such as a copper wire, optical fiber, or wireless signal. The physical layer defines the electrical, mechanical, and procedural interfaces for devices to connect to the network.
   - Some of the key functions of the physical layer include:
     - **Encoding and decoding:** Converting data into electrical signals and vice versa.
     - **Bit synchronization:** Ensuring that the sender and receiver are synchronized so that they can correctly interpret the data.
     - **Bit rate control:** Controlling the rate at which bits are transmitted.
     - **Physical addressing:** Assigning physical addresses to devices on the network.
   - From low to high is 1 and in contrast

=> The physical layer is a critical layer in the OSI model, as it is the foundation upon which all other layers are built. Without the physical layer, it would not be possible to transmit data between devices on a network.

9. Bandwidth anf Throughput:
   A. Bandwidth (Băng thông)
     - **Definition:** Bandwidth is the **theoretical** maximum amount of data that can be transmitted over a network connection within a given amount of time. It's like the size of the pipe through which data flows.
     - **Measured in:** Bits per second (bps), kilobits per second (kbps), megabits per second (Mbps), gigabits per second (Gbps).
     - **Example:** If your internet plan has a bandwidth of 100 Mbps, it means that theoretically, it can transfer up to 100 megabits of data per second.

   B. Throughput (Lưu lượng thực tế)
     - **Definition:** Throughput is the **actual** amount of data that is successfully transmitted and received over a network connection within a given time. It's the actual speed at which data is moving through the pipe.
     - **Measured in:** Bits per second (bps), kilobits per second (kbps), megabits per second (Mbps), gigabits per second (Gbps).
     - **Example:** If you're downloading a file and your throughput is 80 Mbps, it means that you're actually receiving data at a rate of 80 megabits per second.

<table>
<tr><th>Model Type</th><th>OSI Layers</th><th>Protocol Data Unit (PDU)</th><th>TCP/IP Layers</th></tr>
<tr><td rowspan="4">Host Layers</td><td>Application Layer</td><td rowspan="3">Data</td><td rowspan="3">Application Layer</td></tr>
<tr><td>Presentation Layer</td></tr>
<tr><td>Session Layer</td></tr>
<tr><td>Transport Layer</td><td>Segment (TCP) / Datagram (UDP)</td><td>Transport Layer</td></tr>
<tr><td rowspan="3">Media Layers</td><td>Network Layer</td><td>Packet</td><td>Internet Layer</td></tr>
<tr><td>Data Link Layer</td><td>Frame</td><td rowspan="2">Network Access Layer</td></tr>
<tr><td>Physical Layer</td><td>Bit</td></tr>
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