CCNA: Introduction to Network

**Module 4 – 4.2: Physical Layer Characteristics**

**A. Physical Layer Standards**

- The protocols and operations of the upper OSI layers are performed using software designed by software engineers and computer scientists.

- The services and protocols in the TCP/IP suite are defined by the Internet Engineering Task Force (IETF).

- The physical layer consists of **electronic circuitry (mạch điện tử), media (phương tiện), and connectors (đầu nối)** developed by engineers

- Many organizations, both international and national, define and maintain physical layer standards, including those for hardware, media, encoding, and signaling:

* International Organization for Standardization (ISO)
* Telecommunications Industry Association/Electronic Industries Association (TIA/EIA)
* International Telecommunication Union (ITU)
* American National Standards Institute (ANSI)
* Institute of Electrical and Electronics Engineers (IEEE)
* National telecommunications regulatory authorities including the Federal Communication Commission (FCC) in the USA and the European Telecommunications Standards Institute (ETSI)

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**B. Physical Components**

- The physical layer standards address three functional areas:

* Physical Components
* Encoding
* Signaling

- Physical layer components are the hardware that transmits data signals. This includes things like:

* **NICs:** Network Interface Cards
* **Cables & Connectors:** The physical wires and plugs.
* **Interfaces & Ports:** Like those on a router (e.g., the specific shape and function of a USB port).

=> Standards define all these hardware aspects.

**C. Encoding**

Encoding (or line encoding) translates data bits into a recognizable pattern (a "code") for transmission. Think of it like Morse code for digital data. For example, Manchester encoding uses voltage changes to represent 0s and 1s. Different Ethernet speeds use different encoding methods (e.g., 10BASE-T uses Manchester, faster speeds use more complex codes).

A graph with numbers and arrows

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**D. Signaling (Tín hiệu)**

- The physical layer uses signaling methods to represent 1s and 0s as electrical, optical, or wireless signals. Standards define how each bit is represented (e.g., voltage change, light pulse). Like Morse code, it uses patterns to convey information.

- Copper Cable:

A line drawing of a city skyline

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- Fiber Optic Cable

A diagram of light and light

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- Wireless Media

A diagram of a digital signal

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**E. Bandwidth**

- The name for the capacity of a medium to carry data

- Bandwidth measures how much data a medium can carry, *not* how fast the bits travel. It's measured in kbps, Mbps, or Gbps. Higher bandwidth means more data can be sent per second. For example, 100Mbps Ethernet sends more bits per second than 10Mbps, even though the electrical signals travel at the same speed.

- A combination of factors determines the practical bandwidth of a network:

* The properties of the physical media
* The technologies chosen for signaling and detecting network signals

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**E. Bandwidth Terminilogy**

- Terms used to measure the quality of bandwidth include:

* Latency (Độ Trễ)
* Throughput (Thông Lượng)
* Goodput (Thông Lượng Tốt)

- Latency: the total time it takes for data to travel from one point to another, including any delays.

- Throughput: the measure of the transfer of bits across the media over a given period of time

- Due to several factors, throughput usually does not match the specified bandwidth in physical layer implementations. ***Throughput is usually lower than the bandwidth***. There are many factors that influence throughput:

* The amount of traffic
* The type of traffic
* The latency created by the number of network devices encountered between source and destination

- Goodput: the measure of usable data transferred over a given period of time