# Physical Layer - Introduction

## Introduction

Physical layer in the OSI model plays the role of interacting with actual hardware and signaling mechanism. Physical layer is the only layer of OSI which actually deals with the physical connectivity two different stations. This layer defines the hardware equipments, cabling, wiring, frequencies, pulses used to represent binary signals etc.

Physical layer provides its services to Data-link layer. Data-link layer hands over frames to physical layer and physical layer converts it to electrical pulses which represents binary data and sends over to the wired or wireless media.

## Signals

When data is sent over physical medium it needs to be first converted into electromagnetic signals. Data itself can be analog such as human voice, or digital such as file on the disk. Data (both analog and digital) can be represented in digital or analog signals.

- **Digital Signals**

  Digital signals are discrete in nature and represents sequence of voltage pulses. Digital signals are used within the circuitry of a computer system.

- **Analog Signals**

  Analog signals are in continuous wave form in nature and represented by continuous electromagnetic waves.

## Transmission impairment

When signals travel through the medium they tend to deteriorate. This may have many reasons:

- **Attenuation:**

  When signal passes through the medium it tends to get weaker as it covers distance. It loses is strength. For the receiver to interpret the data signal must be sufficiently strong.

- **Dispersion:**

  As signal travels through the media it tends to spread and overlaps. The amount of dispersion depends upon the frequency used.

- **Delay distortion:**

  Signals are sent over media with pre-defined speed and frequency. If the signal speed (velocity) and frequency does not match, there are possibilities that signal reach destination in arbitrary fashion. In digital media, this is very critical that some bits reach earlier than the previously sent.

- **Noise:**

  Random disturbance or fluctuation in analog or digital signals is said to be Noise in signal, which may distort the actual information being carried. Noise can be characterized in one of the following class:

  o **Thermal Noise:**

  Heat agitates the electronic conductors of a medium which may introduce noise in the media. Up to a certain level thermal noise is unavoidable.

- o **Intermodulation:**

  When more than frequency shares a medium their interference can cause noise in the media. Intermodulation noise occurs say, if two different frequencies sharing a media and one of them has excessive strength or the component itself is not functioning properly, then the resultant frequency may not be delivered as expected.

- o **Crosstalk:**

  This sort of noise happens when a foreign signal enters into the media. This is because signal in one media is affecting the signal of second media.

- o **Impulse:**

  This noise is introduced because of irregular disturbances like lightening, electricity short-circuit or faulty components. Digital data is mostly affected by this sort of noise.

# Transmission Media

The medium over which the information between two computer systems is sent, called Transmission Media. Transmission media comes in two forms.

- **Guided Media**

  All communication wires/cables comes into this type of media, such as UTP, Coaxial and Fiber Optics. In this media the sender and receiver are directly connected and the information is send (guided) through it.

- **Unguided Media**

  Wireless or open air space is said to be unguided media, because there is no connectivity between the sender and receiver. Information is spread over the air, and anyone including the actual recipient may collect the information.

# Channel Capacity

The speed of transmission of information is said to be the channel capacity. We count it as data rate in digital world. It depends on numerous factors:

- **Bandwidth:** The physical limitation of underlying media.
- **Error-rate:** Incorrect reception of information because of noise.
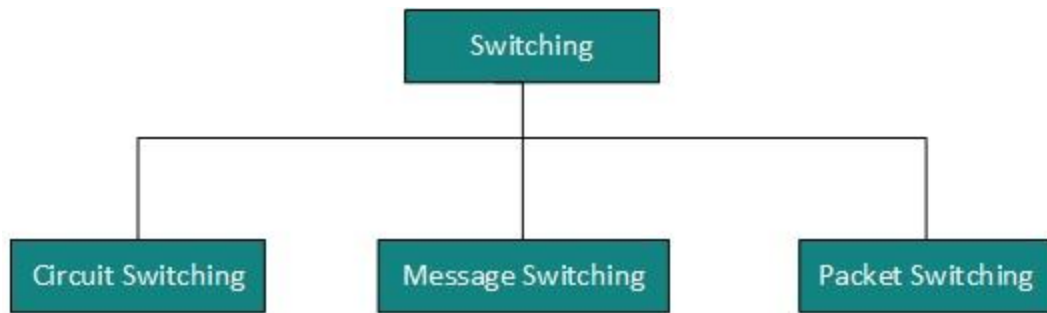- **Encoding:** number of levels used for signaling.

# Multiplexing

Multiplexing is a technique to mix and send multiple data stream over a single media. This technique requires system hardware called Multiplexer for multiplexing streams and sending them on a media and De-Multiplexer which takes information from the media and distributes to different destinations.

# Switching

Switching is a mechanism by which data/information sent from source towards destination which are not directly connected. Networks have interconnecting devices, which receives data from directly connected sources, stores data, analyze it and then forwards to the next interconnecting device closest to the destination.

Switching can be categorized as: