

Physical Layer

The physical layer is the bottom layer in the OSI protocol stack model. It is also the bottom layer in the TCP/IP stack model.

It is concerned with the actual physical connection to the network. Characteristics of the signal are determined in this layer. Examples include:

- Voltage levels
- Timing of voltage changes
- Media length
- Type of transmission being used

Timing of Voltage Changes

Signals are composed of multiple frequencies, which make up the **bandwidth** of the signal.

Both the medium and the signal have bandwidths.

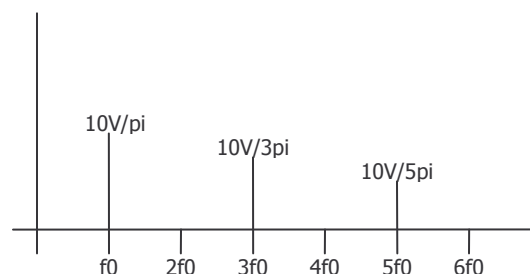
Square waves are composed of (in theory) an infinite number of sine waves of the appropriate frequency and magnitude.

Effective bandwidth – frequency range that contains most of the signal's energy

The signal can be viewed in two different domains:

1. **Time domain** - shows the amplitude of the signal over time.
2. **Frequency domain** - shows the amplitude of the signal vs. the frequency.

Fundamental frequency: $\frac{1}{T} = f_0$



Harmonics are integer multiples of f_0

Telephone lines have a bandwidth of 3 or 4 KHz. If we try to send a 10 KHz signal through the line, it would just be attenuated and not heard on the other end.

What is the effect of trying to transmit 8 bits at various bit rates over a telephone line?

BPS	# Harmonics
300	80
600	40
1200	20
9600	2

$$T = \frac{8bits}{b \text{ bits / s}}$$

$$f_0 = \frac{1}{T} = \frac{b}{8Hz}$$