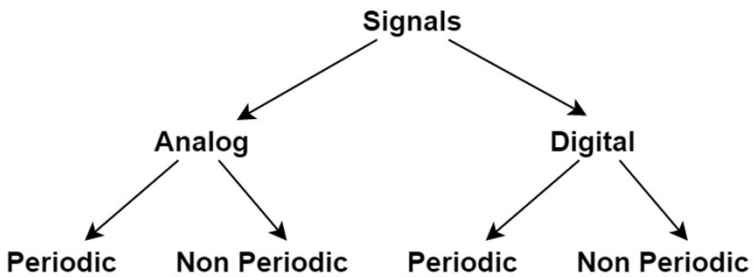
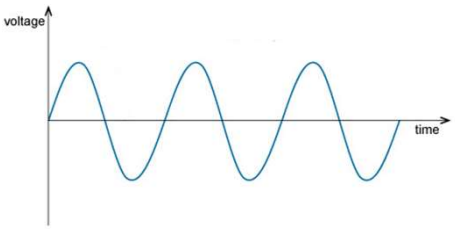
Data Signals

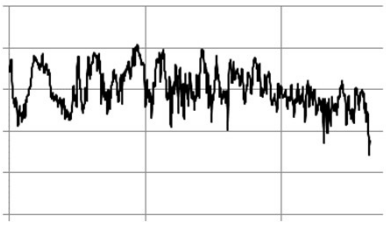
DR. AMRIT PAL

Signal



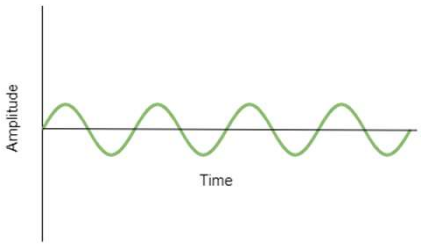
Analog Signals



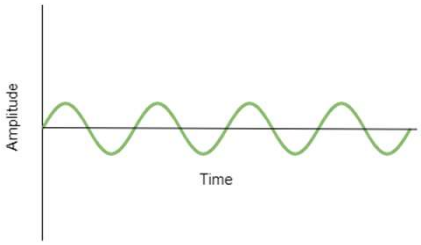


Digital Signal

Data Communication

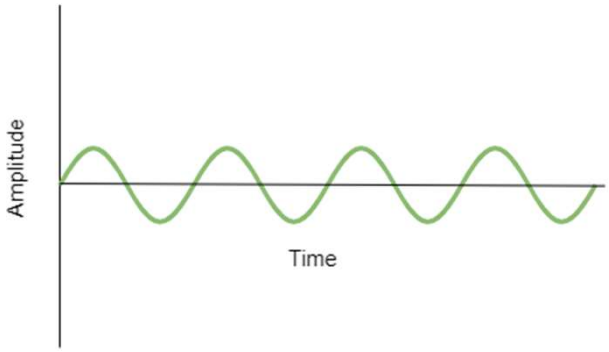


Data Communication



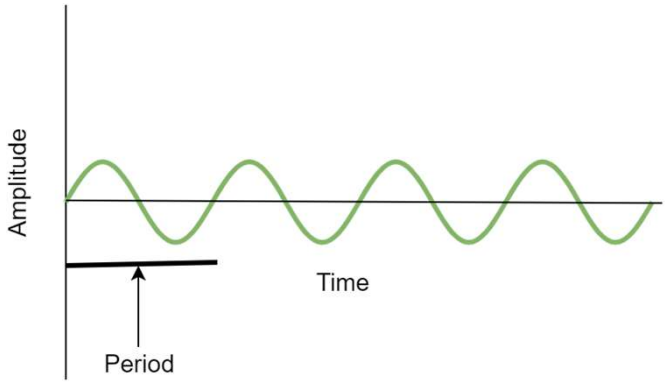
In data communications, we commonly use periodic analog signals and nonperiodic digital signals.

Analog Signals



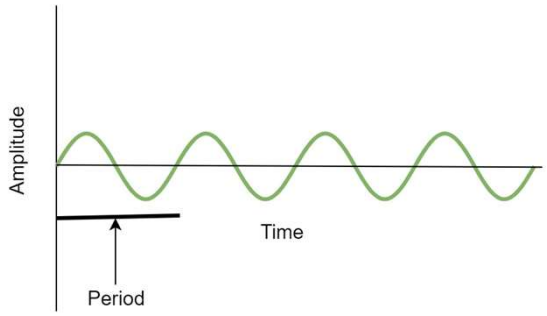
- Pattern
- Period

Analog Signals



- Pattern
- Period
- Periodic Pattern

Analog Signals



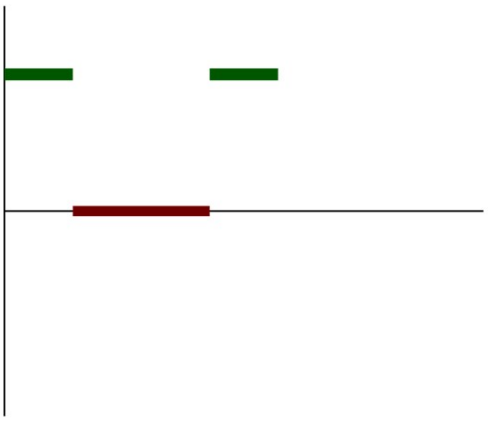
- Pattern
- Period
- Periodic Pattern
- 1 Second
- Frequency
- Wavelength

Frequency

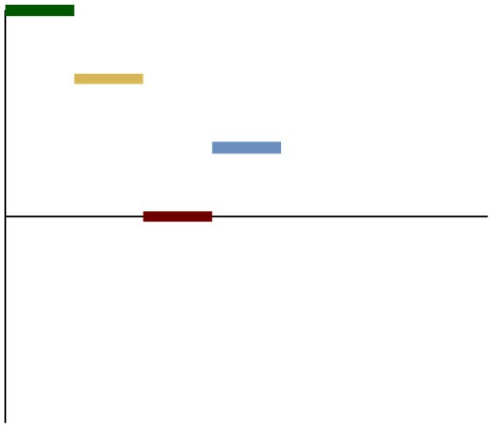
- 50Hz
- Zero
- Infinite

Digital Signals

Two Level Digital Signal



Multi Level Digital Signal



Questions

A digital signal has sixteen levels. How many bits are needed per level?

Some Parameters

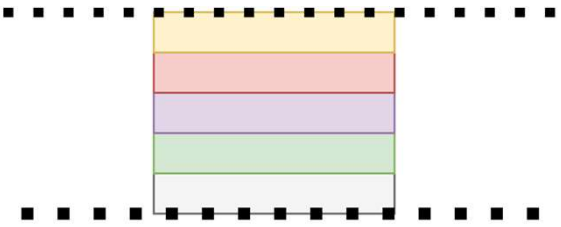
- Bit Rate

Some Parameters

- Bit Rate
- Bit Length

Some Parameters

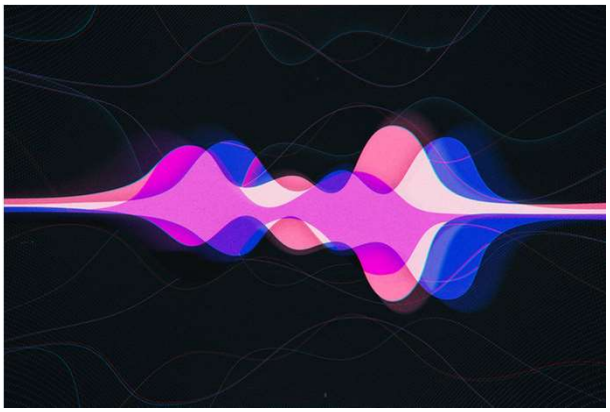
- Bit Rate
- Bit Length
- Frequency
- Bandwidth
- Wavelength

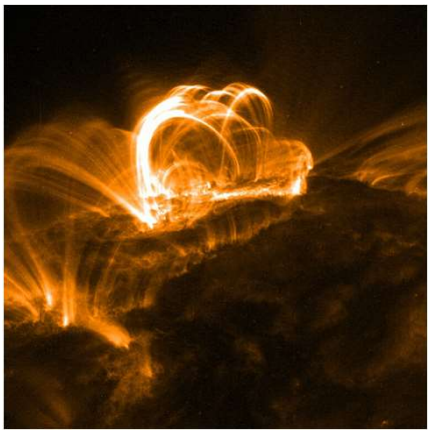


Signals

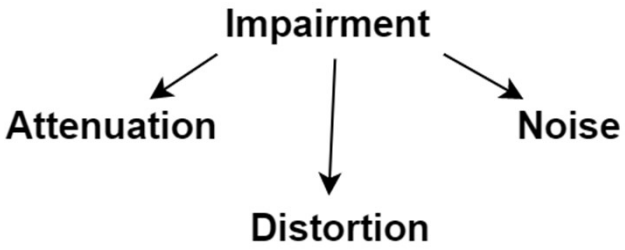
Transmission Impairment

Transmission Impairment





Transmission Impairment



Attenuation

Loss of Energy

Amplifier

How to show that signal has gained or lost strength?

Decibel $dB = 10\ log \frac{P2}{P1}$

Distortion

Noise

Thermal Noise

Induced Noise

Crosstalk

Impulse Noise

Noise

Ratio of signal to noise power

Signal to Noise Ratio= $\frac{\text{Average Signal Power}}{\text{Average Noise power}}$

$$SNR_{dB} = 10\ logSNR$$

Nyquist Bit Rate

For a Noiseless Channel

How Reliable?

$$BitRate = 2 * B * \log L$$

Shannon Capacity

For a Noisy Channel

$$C = B * \log(1 + SNR)$$

How to use?

Channel Bandwidth=1MHz

SNR is 63

$$C = B * \log(1 + SNR)$$

$$BitRate = 2 * B * \log L$$

Questions

Assume we need to download text documents at the rate of 100 pages per minute. What is the required bit rate of the channel?

A page is an average of 24 lines with 80 characters in each line. If we assume that one character requires 8 bits,

Questions

A digital signal has sixteen levels. How many bits are needed per level?

Questions

A periodic signal has a bandwidth of 20 Hz. The highest frequency is 60 Hz. What is the lowest frequency? Draw the spectrum if the signal contains all frequencies of the same amplitude.

Questions

Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with two signal levels. The maximum bit rate?

Consider the same noiseless channel transmitting a signal with four signal levels (for each level, we send 2 bits)

Questions

We need to send 265 kbps over a noiseless channel with a bandwidth of 20 kHz. How many signal levels do we need?

Consider an extremely noisy channel in which the value of the signal-to-noise ratio is almost zero. What is channel capacity for data transmission?

Question

The signal-to-noise is $SNR_{dB} = 36$ and the channel bandwidth is 2 MHz. Calculate the channel capacity.

Question

We have a channel with a 10-MHz bandwidth. The SNR for this channel is 523. What are the appropriate bit rate and signal level?