

is unwanted electrical or electromagnetic noise, degrade a quality of a signal

(1)

Fundamentals of Data and Signals.

⇒ Logical and physical Connections.

Logical connection is a non physical connection between Sender and Receiver

The physical layer Connections is the only connection between Sender and Receiver and it is at the physical Layer.

Introduction to Data and Signals

Data is an ^{entity} ~~and material fact~~ that convey a meaningful ~~information~~ within a Computer system.

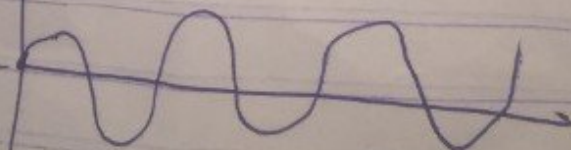
Data and Signals are the two most

It is important ~~that data~~ to understand that data and Signal do not mean the same thing, and that in order for Computer network to transmit data, the ~~data~~ must be converted into appropriate Signal. The only thing data and Signals have in common is that they can be either analog or digital form.

Examples of Data is a computer file contained with names. Signal are the electric or electro magnetic impulses used to transmit data.

Analog vs Digital

Analog Data and Analog Signal are ^{represent} ~~as~~ ^{as continuous} wave form examples such as music and telephone system electronic transmission of voice Conversation, music and voice data.

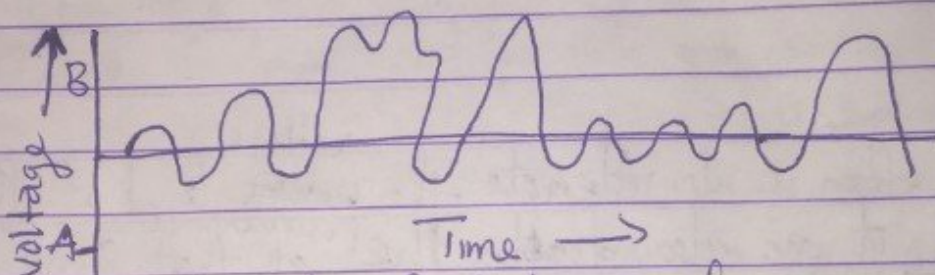
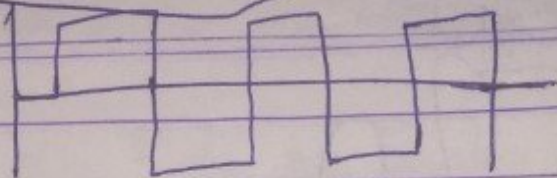
Analogue 

3 basic Components of Analog and digital Signals

②

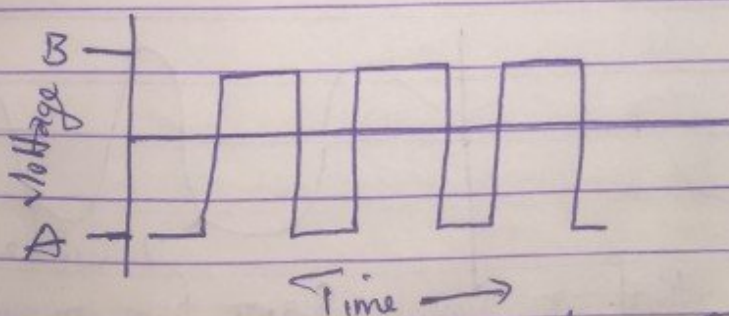
- Amplitude
- frequency
- phase

Digital



Example of Analog waveform

Digital are discrete waveform rather than continuous waveform.
Digital is discrete unlike analogue that is continuous.
i.e. it takes finite number of values. They are less prone to noise.

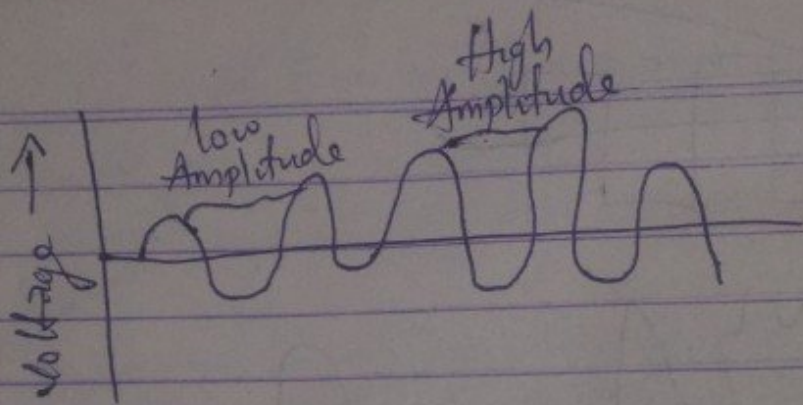


Example of Digital waveform

Fundamentals of Signals.

⇒ Amplitude - is the height of ~~signal~~ the wave, above a given reference point of a signal.

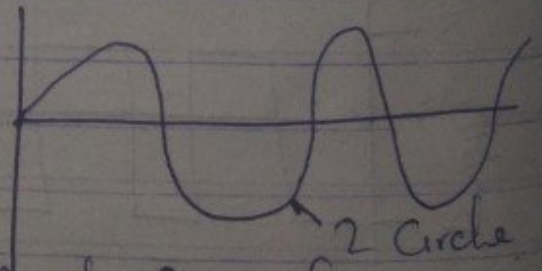
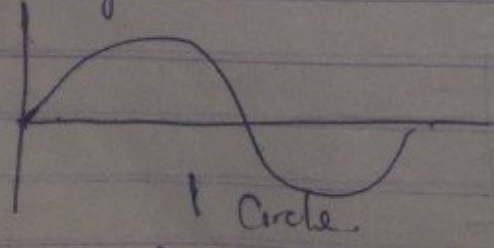
3



This height ~~often~~ is also ~~denote~~ the ^{voltage} ~~current~~ level of the signal and it can also ~~denote~~ the ^{current} level of that signal. It can be measured with volt or watts.

Frequency:

is the number of time a signal made a complete cycle within a given time frame.



The range of frequency that a signal span from minimum to maximum is called "Spectrum" while the band width is the absolute value of the difference between the lowest and the highest frequency of the signal.

Phase

The phase of a signal is the position of the wave form relative to given moment ~~of time~~ or relative to time zero. A change

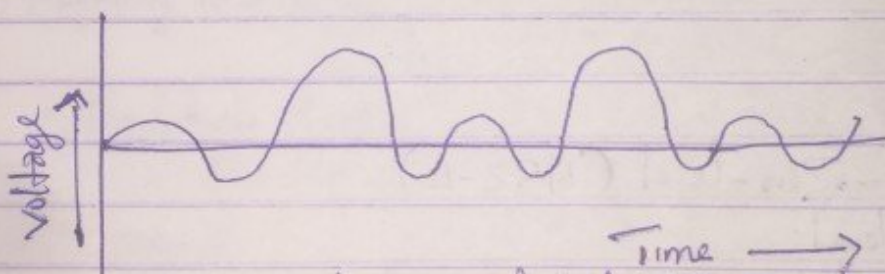
(4)

any of angle
in phase can be number, between 0 and 360

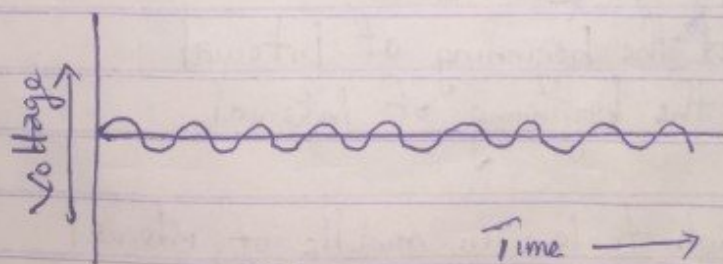
Converting Data into Signals

1) Analogue data ^{transmitted} using Analogue Signal:

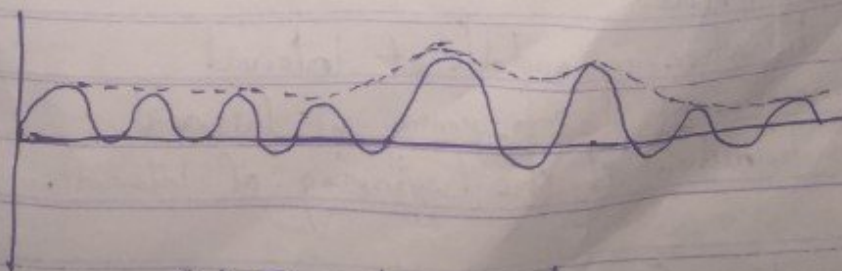
In order to transmit analogue data, you can modulate the data into a set analogue signal. Modulation is ~~loading~~ loading data over a signal by varying either its amplitude, frequency or phase. Broadcast radio and television are two examples of this.



(a) Original Audio wave



(b) Carrier Signal



(c) Composite Signal

(5)

(a). Digital data transmitted using digital signal

To transmit digital data using digital signal, the 0's and 1's of the digital data must be converted to the proper physical form that can be transmitted over a wire or air wave. Thus, if you wish to transmit a data value 1 we could do this by transmitting a positive voltage in the medium while 0 could be transmitted as 0 voltage and vice versa. Digital encoding skill like these are used to convert 0 and 1 into of digital data into appropriate transmission form.

Techniques

1). Nonreturn - to - Zero - level (NRZ-L)

0 = high level

1 = low level

2) Nonreturn - to - Zero Inverted (NRZ-I)

0 = no transition at the beginning of interval

1 = transition at the beginning of interval.

3). Manchester

0 = Transition from high to low in middle of interval

1 = Transition from low to high in middle of interval.

4). Differential Manchester

Always a transition in middle of interval

0 = transition at the beginning of interval

1 = no transition at the beginning of interval.

5). Bipolar

0 = no line signal

1 = positive or negative level.

(8)

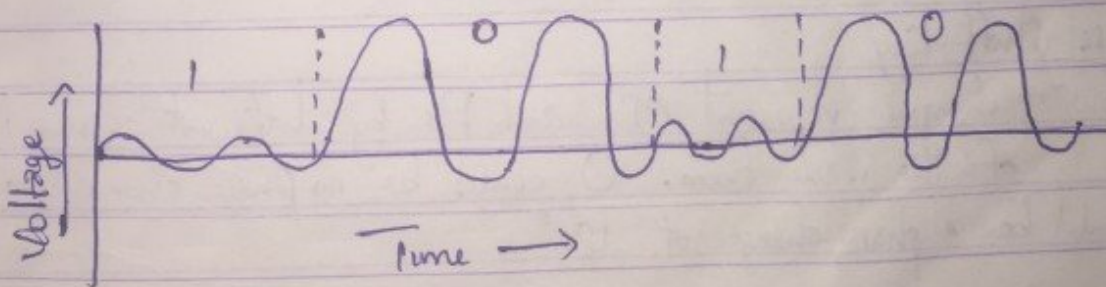
3) Digital data transmitted using Analogue Signal.

Amplitude shifting Key The three current modulation techniques for encoding digital data and transmitting it over analogue signal are (i) Amplitude shifting Key (ii) frequency shifting Key (iii) phase shift Key.

Shift key is a simpler form of modulation in which the binary 1's and 0's are represented by using different values of amplitude, frequency and phase.

(i) Amplitude shifting Key:

In this technique one amplitude encode 0 and the other encode 1



Amplitude shift key as a weakness. (Limitation)

→ It is prone to noise

→ When transmitting data over a standard telephone line amplitude shift key does not exceed 1200 b/s

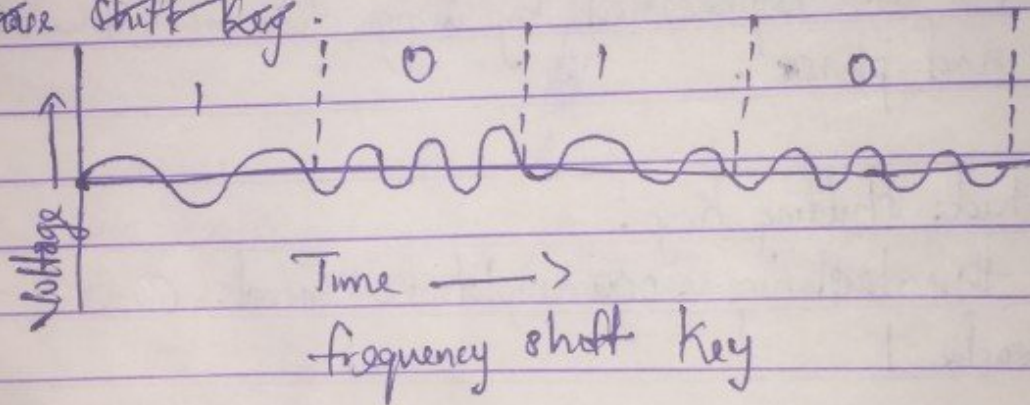
(ii) frequency shift Key

This shift key uses 2 different frequency ranges to represent data values of 0's and 1's. Lower frequency might

(7)

represent 1 while higher frequency might represent 1. Unlike amplitude shift key frequency doesn't have issue with sudden noise spike which makes it a robust encoding key. It is not that perfect, it is prone to intermodulation distortion (when two signals combine to make another signal). This technique is not suitable for system that require high data rate.

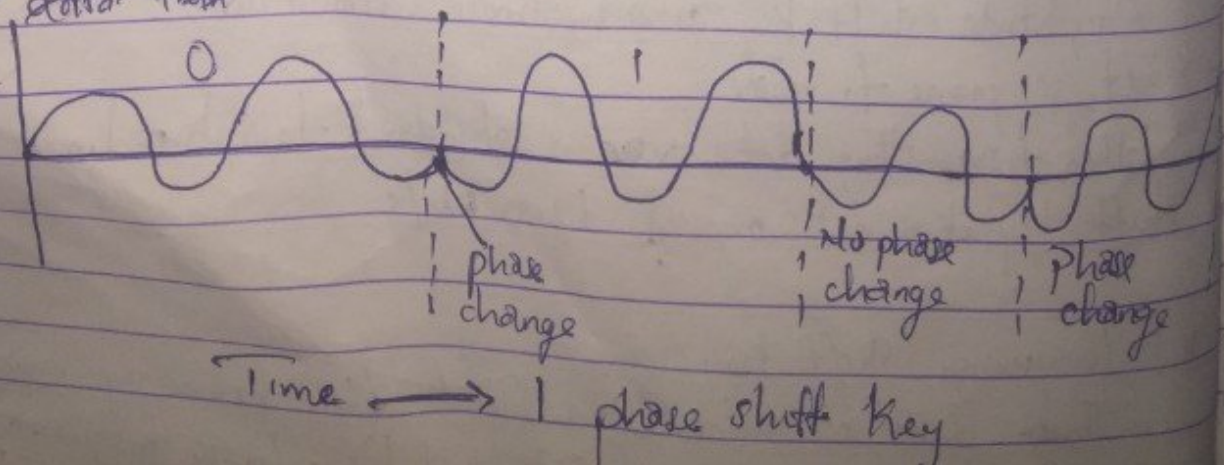
(ii) Phase Shift Key:



(iii) phase Shift Key

This technique represent 0's and 1's by different changes in of the wave form. 0 could be no phase change while 1 could be a phase change of 180°

Analogous data from



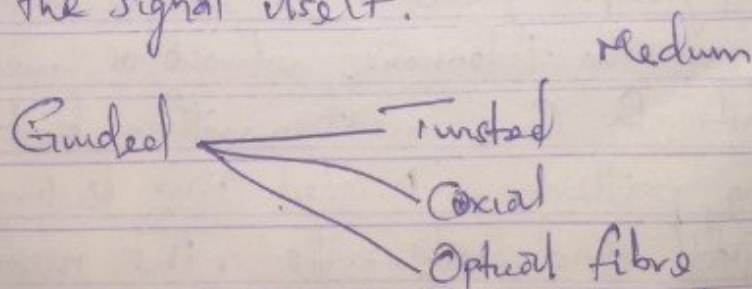
(8)

④ Analogue data transmitted using Digital Signal

Transmission Media / Medium

It is the physical part between transmitter and receiver in a data transmission system. It can be classified as - Guided or Unguided.

In both cases communication is in form of electro magnetic waves, with guided media, the waves are guided along the solid medium such as copper twisted, copper coaxial and optical fibre. The atmosphere and outer space are examples of unguided media that provide a means of transmitting electro magnetic signal without guiding them. The characteristics and quality of data transmission are determined both by the characteristics of the medium and strength of the signal itself.



In considering the design of a data transmission system a key concern, generally, is data rate and distance. The greater the data rate and distance the better. A number of designed factors relating to transmission medium and to the signal determine data rate and distance. Some of these design factors include

(9)

- ① Band ~~width~~ width.
- ② Transmission Impairment
- ③ Interference
- ④ Number of Receiver

Classification of transmission media.

① The Guided transmission media

— Twisted pair is the least expensive and most widely used guided media. It consists of two insulated copper wire arranged in a spiral pattern. A wire pair acts as a single communication line typically, a number of these are bundled together into a cable by wrapping them in a tough protective sheath. Over longer distance, cables may contain 100's of pairs. The wire in a pair have thickness of from 0.016 to 0.036 inches. It is used for both analog and digital signals. It is the most commonly used medium on the telephone network as well as being the work hub for communication within building for ~~LAN~~ supporting pattern. Twisted pair is limited in distance band width and data rate. The medium is quite prone to interference and noise.

Types

- ① Shielded pair
- ② Unshielded pair

(10)

⑩ Coaxial Cable: Permit

It is constructed differently to conduct over wider range of frequency. It consists of hollow outer cylindrical conductor that surround a single inner wire conductor. The inner conductor is held in place by either regularly spaced insulating ring or a solid dielectric material. The outer conductor is covered with a shield or jacket. A coaxial cable has a diameter of 0.4 to 1 inch. It is less susceptible to noise interference than twisted pair because of its shield and concentric construction. The principal ~~connect~~ ^{Advantages} of coaxial cable are:

(i) Thermal noise and intermodulation noise

(ii) Television distribution

(iii) Long distance telephone transmission

(iv) Short run computer system link

LAN and examples of uses of coaxial cable can be used to transmit both analog and digital signals.

⑪ Optical fibre:

It is a tiny, flexible medium capable of conducting an optical ray. Glass and plastic can be used to make optical fibre. It has a cylindrical shape and consists of 3 concentric sections.

(i) The Core — it is the innermost part

(ii) Cladding — outermost part

(iii) Jacket

(11)

Characteristics of Optical fibre

- ① Greater Capacity
- ② Smaller Size and lighter weight
- ③ Lower ~~Attenuation~~
- ④ Electromagnetic isolation

② Unguided transmission media:

we have 3 type of Unguided which are:

- (A) Terrestrial Microwave
- (B) Satellite "
- (C) Cellular Telephone

(A) Terrestrial Microwave:

It transmit tightly focused ~~beams~~ of radio signal from one ground base microwave transmission antenna to another. Its most common application area are

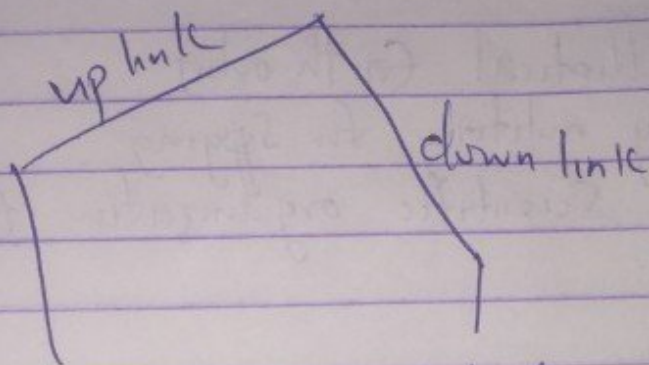
- telephone communication
- Business Intercommunication

The distance is ~~from~~ between 20-30 mile. The higher the tower the farther the possible transmission signal.

~~The~~ Disadvantages.

- ① Loss of signal strength Attenuation
- ② Interference from other signal
- ③ In addition to ^{rather} cause of leaving service or installing and maintaining the antenna.

⑧ Satellite Microwave:



It is similar to terrestrial microwave system except that the signal travel from ground station on earth to satellite (uplink) and back to another ground station that achieving much greater distance than earth bound line of sight transmission. The closer a satellite is to the earth the shorter the time required to send the data to the satellite and receive data from it.

Different categories of satellite (Classification).

- (i) LEO - Low earth orbit (100 - 1000 miles out)
- (ii) MEO - Middle earth orbit (1000 - 22,300 miles)
- (iii) GEO - Geosynchronous earth orbit (22,300 and above).
- (iv)

(i) LEO

It is used for wireless emails, Special mobile, pagers telephone, Spying, and video Conferencing.

(ii) MEO

(iii) GEO

It is used for GPS and other government agency.

(13)

It is used for weather forecasting ~~and~~ television.

(iv) HEO - highly elliptical Earth orbit
It is used by military for spying
It is a scientific organization for photographing
celestial bodies.