

Chapter - 7

- 4 hrs

Impairments, Error handling & compression

Technique

Q. Define Impairments. What are the basic signal impairments in comm? system.

Impairments :-

- In communication system, the signal that is received may differ from ^{the} various signal that is transmitted due to various transmission Impairments.
- For analog signals ~~that~~ these impairments can degrade the signal quality.
- For digital signals, bit errors (ie altering of bits) may be introduced.

The basic signal impairments are

- ① Attenuation.
- ② Distortion
- ③ Noise
- ④ Crosstalk.
- ⑤ Interference.
- ⑥ Echo
- ⑦ Jitter.

(1) Attenuation :-

- Attenuation means a loss of energy, when a signal travels through a medium, its strength decreases with distance.
- Attenuation is generally exponential & thus is typically expressed as a constant number of decibels per unit distance.
- Amplifiers or repeaters are used to increase the signal strength.
- Beyond a certain distance, the attenuation becomes unacceptably great, & repeaters or amplifiers are used to boost the signal at regular intervals.

(2) Distortion :-

- Distortion means that the signal changes its form or shape ie it is unwanted signal fluctuating in signal & in deterministic manner.
- Each signal component has its own propagation speed through a medium & therefore, its own delay through a medium & therefore its own delay in arriving at the final destination.
- Distortion is two type

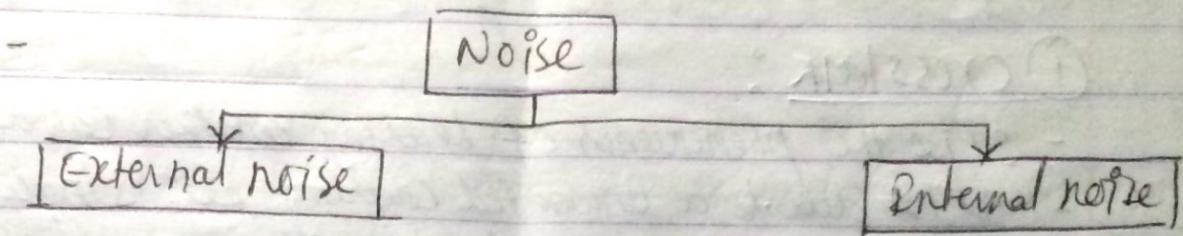
(a) Amplitude distortion :- It is the distortion in amplitude of a signal.

(b) Phase distortion (Delay distortion) :- Change in phase of a signal is called phase distortion, generally it occurs at receiver end, ie some component take time at receiver.

~~QUESTION~~

(3) Noise:

- Noise may be defined as an unwanted form of energy which tends to interfere with the proper reception & reproduction of transmitted signals.



- Noise which is generated external to a comm. system
- atmospheric noise, Industrial noise, galactic noise.
- noise which is generated internally or within the comm. system
- shot noise, thermal noise.

Galactic noise :- noise due to cosmic ray from galaxies.

Shot noise :- It arises in active devices due to random behaviour of charge carriers. In electron tubes shot noise is generated due to the random emission of electrons from cathodes. In s/c materials or devices shot noise generated due to the random diffusion of minority carriers.

Thermal noise : It is also called white noise, or Johnson noise, it is the random noise which is generated in a resistor or the resistive component of a complex impedance due to rapid & random motion of the molecules atoms & electrons.

Some other noise source

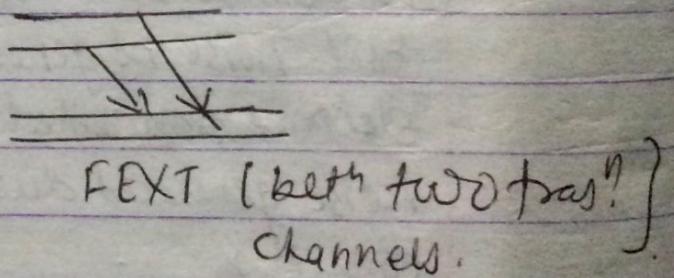
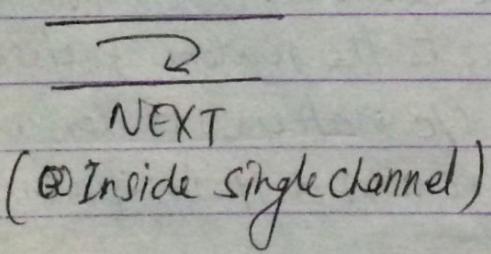
- ① Crosstalk.
- ② Interference
- ③ Echo

① Crosstalk:

- It is the phenomenon of hearing another conversation.
- It is due to an unwanted coupling b/w single paths. It can occur by electrical coupling b/w nearby twisted pair or Co-axial cable (rarely) lines carry multiple signals.
- In case of real life experience of crosstalk is while using the telephone, we hear another conversation.
- Two types.

① Near End Crosstalk (NEXT)

② Far End Crosstalk (FEXT)



② Interference: - Inductive & capacitive coupling of unwanted signals are called interference.

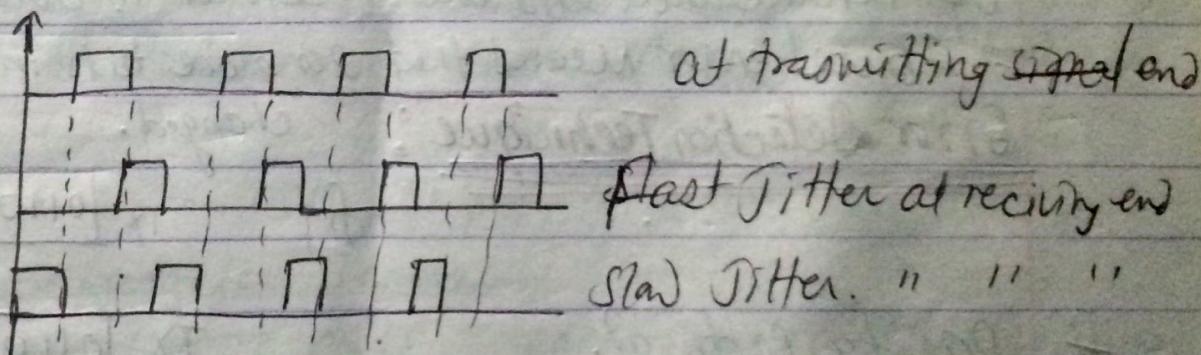
- It is the type of signal impairments in which one signal interfere the freq? component of another signal.
- Here the freq? component of two signals interfere each other & loss of certain components.

③ Echo

- It is the result of transmitting signals being coupled into return path of feedback to the respective source.
- It occurs as a result of coupling mechanism between two wires & four wires cable.
- The signal reflected to the speaker end of the circuit is called talker echo.

④ Jitter

- Jitter is the movement of zero crossing of a signal from their expected time of occurrence.



Types of Error:

- In digital transmission systems, an error occurs when a bit is altered b/w transmission & reception.
- i.e Binary '1' is transmitted & a binary '0' is received or a binary '0' is transmitted & a binary '1' is received
- Two general types of error can occur: single bit error & burst errors.
- A single bit error is an isolated error condition that alters one bit but does not affect nearby bits.
- A burst error of length 'B' is a contiguous sequence of B bits in which the first & last bits & any number of intermediate bits are received in error.
- A burst error means that 2 or more bits in the data unit have changed.

Error Detection Technique:

fig TX | 0110 1001 | RX | 0110 0000 |
single bit error.

Parity Coding:

TX | 0110 1001 | RX | 0010 1010 |
Burst error

- It is the simplest method of coding.
- In this method, parity bits are added to the message at the time of transmission.
- At the reception end, receiver checks these parity bits.
- Errors are detected if the expected pattern of parity bits is not received.

Q. Define error & its type. Explain error detection techniques.

Parity may be of two types.

i) Even parity:

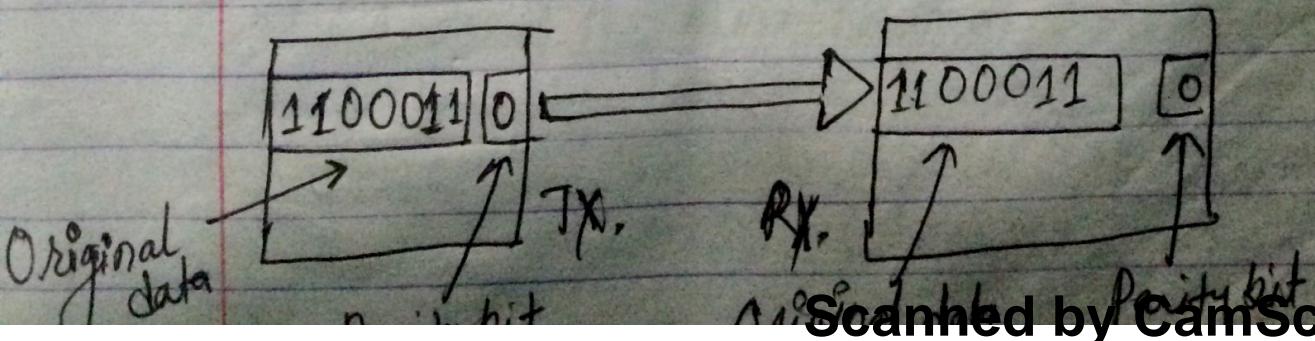
- The parity of a binary word is known as even if it contains even no. of 1's eg 01101001 has even parity since there are four no. of 1's in the word.

ii) Odd parity:

- The parity of a binary word is known as odd if it contains odd no. of 1's eg 01001001

Vertical Redundancy Check (VRC)

- In this method the parity check is done on each character separately.
- In ~~ASCII~~ code, each character has seven binary digits. Also one redundant digit is added to each character to make the parity odd or even.



Redundancy:- Repetition of messages to reduce error detecting technique. The probability of errors in transmission.

- During the transmission of code, if error is occurred ie $1100011 \boxed{0} \rightarrow 1100\boxed{1}11 \boxed{1}$
↑ ↑
error. parity
change
ie odd parity
- If the transmission impairments cause bit flip identify it & detect that error of 1 to 0 or 0 to 1 the parity check identify it & detect that error has occurred.
- If two digits are in error then no. of 1's in the received message is even, in this case receiver will detect no error.
- This is the drawback of VRC.
- VRC check error only one direction ie either in row or in column.

② Longitudinal Redundancy Check (LRC).

11010110	00111101	01101101	11100111
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(original data arranged in row) \hookrightarrow 1 parity

11010110

 \longrightarrow ① 1 parity bit

00111101

 \longrightarrow ② 1. "

01101101

 \longrightarrow 1 "

11100111

 \longrightarrow 0 "

- A block of bit is organised in the form of rows. If we want to send 32 bit we arrange them into a list of four rows.
- Then the parity bit of each column is calculated & a new row of 8 bit is created this becomes the parity bit for LRC as shown in above fig.
- It is complex but can correct double or triple errors.

③ cyclic Redundancy Check (CRC).

- It is one of the most common & most powerful error detecting technique.
- In CRC, the user data stream is divided by a predetermined binary no.

- The remainder of the no. is appended to the message as a frame check sequence field (FCS)
- Then the data is transmitted towards the receiving end.
- At the receiving end another calculation is performed & then compared with FCS field. If the remainder ie difference is '0' then the message is error free & thus accepted by the receiver.

④ Check sum (last page)

Types of Data Compression Techniques.

- To send audio or video over the Internet we require compression techniques.
- There are different types of ^{audio} compression & video compression.
- It is usually acceptable to have the audio or video signal after encoding & then decoding be slightly different from original.
- When the decoded o/p is not exactly equal to the original o/p, the system is said to be lossy. The system is said to be lossless if compression is lossless.

- When the decoded op is exactly equal to the original ip, the system is said to be lossless & compression is lossless compression.

There are two standard.

(1) JPEG - Joint photographic experts Group is standard for compressing continuous tone still pictures. It was developed by photographic experts working under ITU, ISO, & other standards.

(11) MPEG Standard - (Motion pictures experts group)

- It can compress both audio & video.

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Q.

What is error in data transmission. Explain the operation of Checksum for error detection purpose with an example

⇒ Checksum

- It is also error detection technique, it is also based on the concept of Redundancy.

Sender side :

- (1) The message is divided into 16 bit words.
- (2) The value of checksum word is set to '0'.
- (3) All words including the checksum are added using one complement addition.
- (4) The sum is complemented & becomes the checksum.
- (5) The checksum is sent with the data.

Receiver side

- (1) The message including checksum is divided into 16 bit words.
- (2) all words are added using 1's complement addition.
- (3) The sum is complemented & becomes the new checksum.
- (4) If the value of checksum is '0' the message is accepted, otherwise it is rejected.

eg. 10101001 00111001

Transmitter

$$\begin{array}{r} \text{Data} \\ \text{Segment 1} \\ \text{Segment 2} \\ \text{Sum} \end{array} \quad \begin{array}{l} 10101001 \\ 00111001 \\ \hline 11100010 \end{array}$$

Receiver

1st complement

$$\begin{array}{r} 00011101 \\ 10101001 \\ 00111001 \\ \hline 14110011 \end{array} \quad \begin{array}{l} \leftarrow \text{check sum.} \\ \leftarrow \text{Data} \end{array}$$

A

$$\begin{array}{r} 14110011 \\ \hline \text{sum.} \end{array}$$

→ 1's complement 0000 0000 Data accepted.

New check sum

Value is '0' so accepted.

* If MSB of received data segment 1 is inverted then at receiver.

$$00011101 \leftarrow \text{check sum.}$$

A

$$\begin{array}{r} 00101001 \\ 00111001 \\ \hline \text{data.} \end{array}$$

error bit →

$$\begin{array}{r} 01111111 \\ \hline \text{sum} \end{array}$$

$$10000000 \leftarrow \text{check sum.}$$

Data rejected error in 1st bit error detected

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