Q1. Select the correct answer of the given ones. (10)

1) Interactive transmission of data independent of a time-sharing system may be best suited to.
   (a) simplex lines (b) half-duplex lines (c) full-duplex lines (d) biflex lines
2) The loss in the signal power as of an Electromagnetic signal is called
   (a) attenuation (b) propagation (c) scattering (d) interruption
3) Early detection of packet losses improves positive acknowledgment performance.
   (a) odd (b) even (c) positive (d) negative
4) Additional signal introduced in the desired signal in producing hypes is called.
   (a) fading (b) noise
   (c) scattering (d) dispersion
5) Token is a Klingon that rotates around the ring.
6) Ring may have up to ____________ (802.5) or ____________ (IBM) nodes.
7) FDDI can support a maximum of 500 stations.
8) Error-correcting codes are probably not enough to handle all errors.
9) ACK is a small signal confirming reception of an earlier frame
10) Electronics are ________________ as compared to optics.

Q2: Distinguish between error correction and error detection. Explain any two error detection techniques with mathematical examples other than given in slides, search from internet. (10)

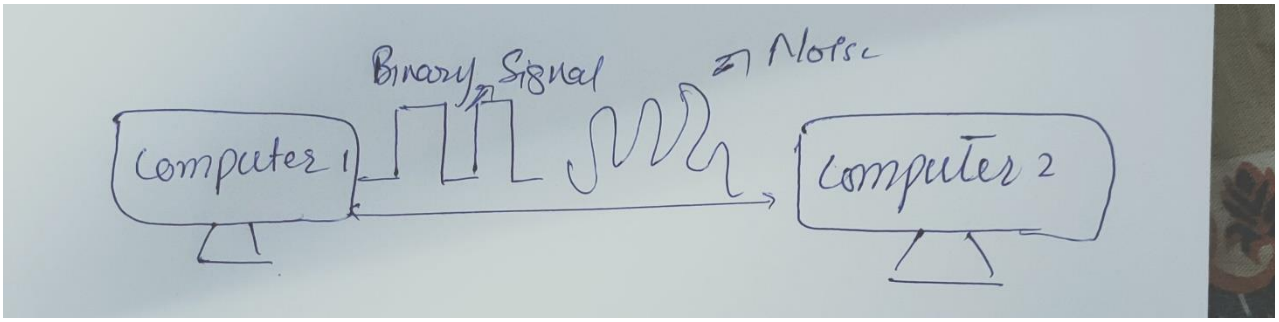
Ans: In information theory and coding theory with applications in computer science and telecommunication, error **detection** and **correction** or error control are techniques that enable reliable delivery of digital data over unreliable communication channels. Many communication channels are subject to channel noise, and thus errors may be introduced during transmission from the source to a receiver. Error detection techniques allow detecting such errors, while error correction enables reconstruction of the original data in many cases.

Error detection is the detection of errors caused by noise or other impairments during transmission from the transmitter to the receiver. Error correction is the detection of errors and reconstruction of the original, error-free data.

Error correction and detection is a Data Link layer function. As we know that data can be corrupted during transmission. Some applications require that errors be detected and corrected. Error detection involves checking whether any error has occurred or not. The number of error bits and the type of error does not matter. Whereas Error correction involves as determine the exact number of bits that has been corrupted and the location of the corrupted bits.

What is Error?

Error is a condition when the output information does not match with the input information. During transmission, digital signals suffer from noise that can introduce errors in the binary bits travelling from one system to other. That means a 0 bit may change to 1 or a 1 bit may change to 0.



Error Detection Techniques:

1. Longitudinal Redundancy Check

In telecommunication, a longitudinal redundancy check, or horizontal redundancy check, is a form of redundancy check that is applied independently to each of a parallel group of bit streams. The data must be divided into transmission blocks, to which the additional check data is added. The term usually applies to a single parity bit per bit stream, calculated independently of all the other bit streams, although it could also be used to refer to a larger Hamming code.

This "extra" LRC word at the end of a block of data is very similar to checksum and cyclic redundancy check .

Optimal rectangular code

While simple longitudinal parity can only detect errors, it can be combined with additional error-control coding, such as a transverse redundancy check, to correct errors. The transverse redundancy check is stored on a dedicated "parity track".

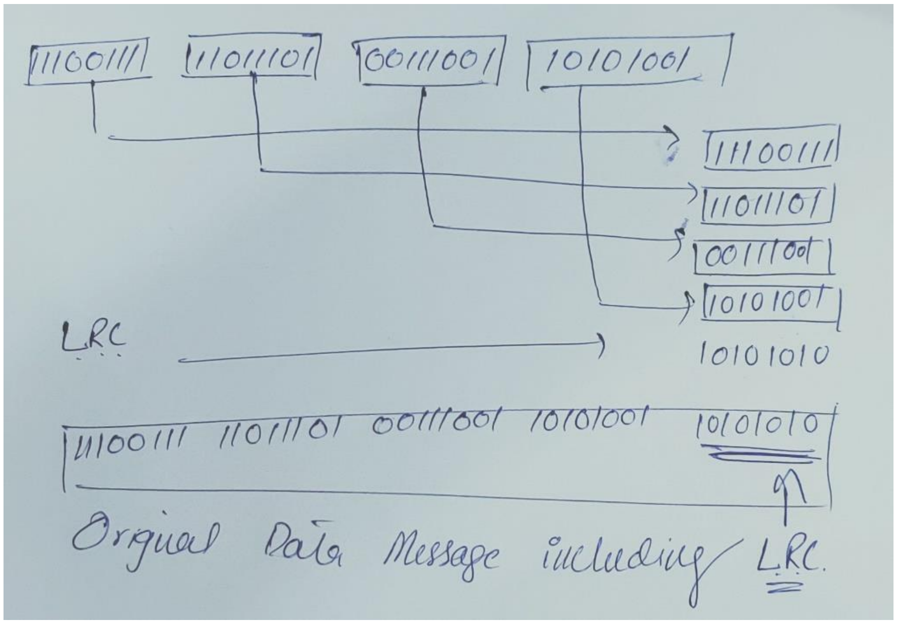
Whenever any single-bit error occurs in a transmission block of data, such two-dimensional parity checking, or "two-coordinate parity checking", enables the receiver to use the TRC to detect which byte the error occurred in, and the LRC to detect exactly which track the error occurred in, to discover exactly which bit is in error, and then correct that bit by flipping it.

Pseudocode International standard ISO 1155 states that a longitudinal redundancy check for a sequence of bytes may be computed in software by the following algorithm.

LRC: 0
for each byte b in the buffer do
lrc : and 0Xff
lrc : and 0xFF
which can be expressed as "the 8-bit two's-complement value of the sum of all bytes modulo 28".

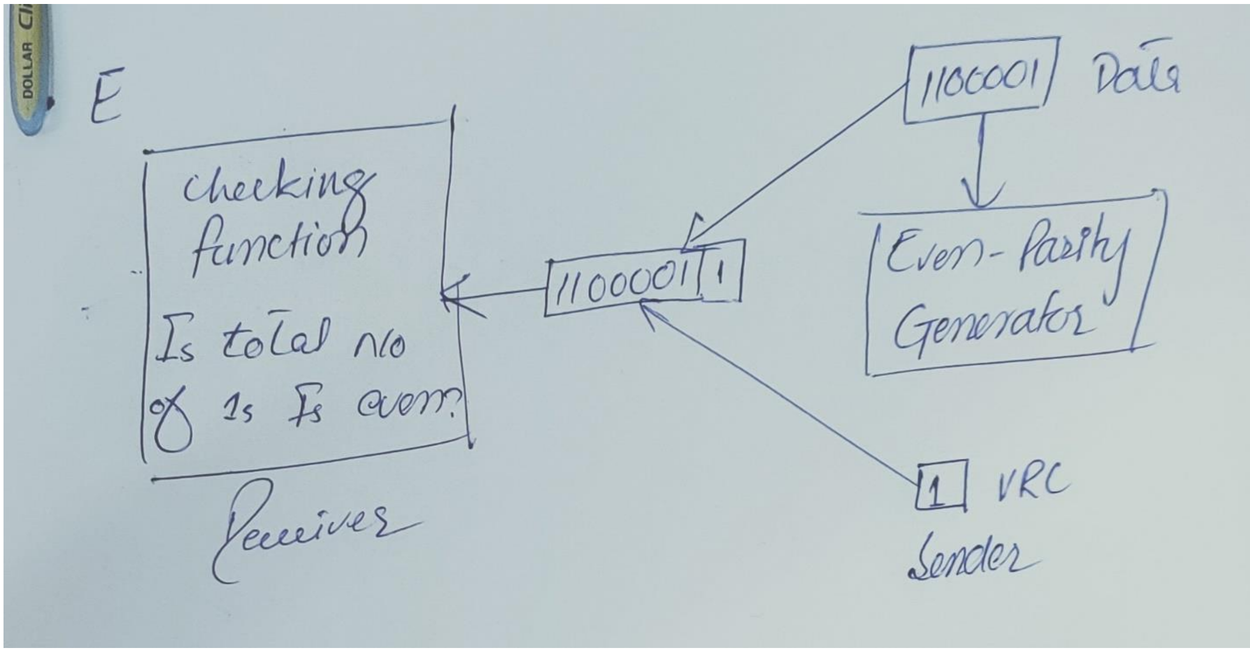
Other Forms:

Many protocols use an XOR-based longitudinal redundancy check byte, including the serial line internet protocol, the IEC 62056-21 standard for electrical-meter reading, smart cards as defined in ISO/IEC 7816, and the ACCESS. Bus protocol. An 8-bit LRC such as this is equivalent to a cyclic redundancy check using the polynomial x8 + 1, but the independence of the bit streams is less clear when looked at in that way.



2. Vertical Redundancy Check

In broadcast communications, a transverse excess check or vertical repetition check is an excess check for synchronized equal bits applied once per bit time, over the bit streams. This requires extra equal channels for the check bit or bits. The term for the most part applies to a solitary equality bit, despite the fact that it could likewise be utilized to allude to a bigger Hamming code. The descriptive word "transverse" is frequently utilized when it is utilized in blend with extra mistake control coding, for example, a longitudinal repetition check. In spite of the fact that equality alone can just recognize and not right blunders, it tends to be a piece of a framework for rectifying mistakes. A case of a TRC is the equality kept in touch with the ninth track of a 9 track tape.



Q3: What is encoding? Write down different types of encoding. Explain characteristics of AM, FM and PM with mathematical equations. (10).

Ans: What is encoding ?
In communications and information processing, code is a system of rules to convert information—such as a letter, word, sound, image, or gesture—into another form or representation, sometimes shortened or secret, for communication through a communication channel or storage in a storage medium. An early example is the invention of language, which enabled a person, through speech, to communicate what they saw, heard, felt, or thought to others. But speech limits the range of communication to the distance a voice can carry and limits the audience to those present when the speech is uttered. The invention of writing, which converted spoken language into visual symbols, extended the range of communication across space and time.

Encoding is the process of using various patterns of voltage or current levels to represent **1s** and **0s** of the digital signals on the transmission link. (Or) Encoding is the process of converting the data or a given sequence of characters, symbols, alphabets etc., into a specified format, for the secured transmission of data.
Different types of encoding:

- **Analog data to Analog signals** − The modulation techniques such as Amplitude Modulation, Frequency Modulation and Phase Modulation of analog signals, fall under this category.
- **Analog data to Digital signals** − This process can be termed as digitization, which is done by Pulse Code Modulation PCM. Hence, it is nothing but digital modulation. As we have

already discussed, sampling and quantization are the important factors in this. Delta Modulation gives a better output than PCM.

- **Digital data to Analog signals** − The modulation techniques such as Amplitude Shift Keying ASKASK, Frequency Shift Keying FSKFSK, Phase Shift Keying PSKPSK, etc., fall under this category.
- **Digital data to Digital signals** − There are several ways to map digital data to digital signals. Some of them are − Non Return to Zero, NRZ - L ,NRZ - I

Characteristics of AM, FM, PM with mathematical equations

1: Phase Modulation (PM):

It is a form of angle modulation in which the angle θi (t) is varied linearly with the message signal m(t),

$$\theta_i(t) = 2\pi f_C\, t + \phi(t)$$

carrier — not a constant

Where $\phi(t) = k_P m(t)$

$$\therefore \theta_i(t) = 2\pi f_C t + k_P m(t) \quad (2.3)$$

The term 2 f t π C represents the angle of the carrier; the constant P k represents the phase sensitivity of the modulator , expressed in radians per volt on the assumption that m(t) is a voltage waveform. The phase modulated signal s(t) is thus described in the time domain by

$$S(t) = A_C \cos[2\pi f_C t + k_P m(t)]$$

2: Frequency modulation (FM)

Frequency modulation is that from of angle modulation in which the instantaneous frequency i f (t) is varied linearly with the message signal m(t):

$$f_i(t) = f_C + k_f m(t) \quad (2.5)$$

The term Cf represents the frequency of the unmodulated carrier and the constant f k represents the frequency sensitivity of the modulator, expressed in hertz per volt on assumption that m(t) is a voltage waveform . Integration equation (2.5) with respect to time we get,(after multiplying by2π).

$$\theta_i(t) = 2\pi f_C + 2\pi k_f \int_0^t m(\tau)\, d\tau \quad (2.6)$$

Amplitude modulation (**AM**) is a modulation technique used in electronic communication, most commonly for transmitting information via a radio carrier wave. In amplitude modulation, the amplitude (signal strength) of the carrier wave is varied in proportion to that of the message signal being transmitted.

Q4: Answer:

(1) Token Ring is single access, meaning there is only one token. Thus, at any given time only one station is able to use the LAN whereas Ethernet is a shared access medium, where all stations have equal access to the network at the same time.

(2) Token Ring gets defined as the local area network which has the properties to transmit the node only when it has certain pieces in succession that come from the other successive nodes turn by turn whereas Ethernet gets defined as the system used for connecting various computers to form a local area network and has different protocols to ensure the passage of information takes place smoothly.

Which one is better?

In my opinion Ethernet is better than token ring .

1) Ethernet is several times faster than the 16M bit/sec token ring as a general rule

2) The cost of Ethernet hardware is far cheaper than token ring ever was with $15 network cards and $40 hubs.

Q5 Answer:

Paper Name: Reliable Transmission of Short Packets through Queues and Noisy Channels under Latency and Peak-Age Violation Guarantees

Reference: https://sci-hub.tw/https://ieeexplore.ieee.org/abstract/document/8640078

The above paper investigates the probability that the delay and the peak-age of information exceed a desired threshold in a point-to-point communication system with short information packets. The packets are generated according to a stationary memory less Bernoulli process, placed in a single-server queue and then transmitted over a wireless channel. A variable-length stop feedback coding scheme—a general strategy that encompasses simple automatic repetition request (ARQ) and more sophisticated hybrid ARQ techniques as special cases—is used by the transmitter to convey the information packets to the receiver. By leveraging finite-block length results, the delay violation and the peak-age violation probabilities are characterized without resorting to approximations based on large-deviation theory as in previous literature. Numerical results illuminate the dependence of delay and peak age violation probability on system parameters such as the frame size and the undetected error probability, and on the chosen packet-management policy. The guidelines provided by our analysis are particularly useful for the design of low-latency ultra-reliable communication systems.