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1. a) What is line coding? Mention different types of line coding. 7

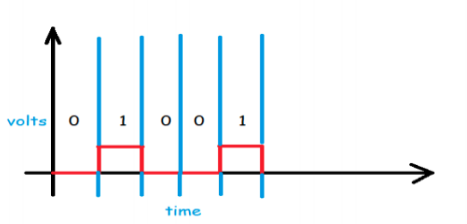
Ans:

Line coding: In telecommunication, a line code is a code chosen for use within a communications system for baseband transmission purposes. Line coding is often used for digital data transport.

There are 3 types of Line Coding

- Unipolar
- Polar
- Bi-polar

Unipolar Line Coding



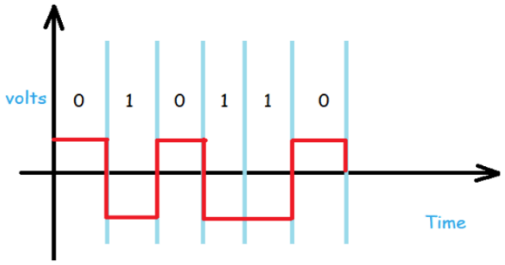
In Unipolar we are simply representing a signal in a graphical form where positive voltage represents logical or binary 1 and zero voltage represents logical zero. We can say that it's the simplest line code.

NRZ (Non-Return to Zero):

The term Non-Return to Zero (NRZ) means that the signal will not return to zero in middle of the bit. Unipolar schemes were generally designed as NRZ schemes. But if we compare it to the polar NRZ scheme, this scheme leads to wastage of power i.e. the normalized power is almost double as compared to polar NRZ.

Polar Line Coding

As its name suggests polar which means it will have both positive and negative values for voltages or amplitude, it is quite like NRZ scheme but, here we have NRZ-L and NRZ-I

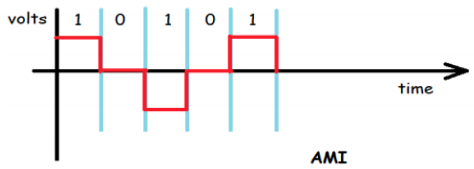


In the above diagram, we can simply notice that high volt is for logical 0 and low volt is for logical 1. This is the representation of NRZ-Level.

Return to Zero (RZ): Return to zero proved out to be a nice alternative or say a solution to NRZ drawbacks. Unlike NRZ, RZ uses three values of voltage i.e. positive, negative, zero. And as the name suggests it returns to zero in the middle of each bit.

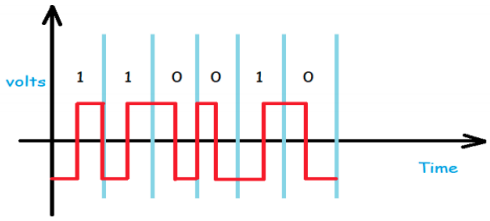
Bipolar Line Coding

Bipolar consists of three voltage levels which are positive negative and zero. While representing, the voltage level for one bit of data is at zero, and the other bit inverts of transits or alternates between positive and negative voltage.



Manchester Line Coding:

Each binary 1 is represented by a positive half–bit period pulse followed by a negative half–bit period pulse. Similarly, a binary 0 is represented by a negative half–bit period pulse followed by a positive half–bit period pulse. This type of signaling is also called split–phase encoding.



b) What is thermal noise? Mention some pros and cons of digital communication. 7

Ans:

Thermal noise: Radio-receiver or amplifier noise due to thermal agitation of the free electrons in the circuit and the tubes and it is created by the random motion of charge carriers due to thermal excitement.

For analog communication systems -

Pros:

1. Less tolerance by the term noise.
2. flexibility with bandwidth.
3. Ambient weather Dependencies are low.
4. Easy to handle not expensive, over sensitive routings.
5. less sensitive in the terms of electrical tolerance.

Cons:

1. Not easy to implement.
2. Needed perfect receiver and Transmitter for specific communication scenario. If you move into a new system and you want to change the analog signal you need to tune or change both receiver and Transmitter.
3. No security for transmission data.
4. Can't be saved and transmit under urgency.

For digital communication systems -

Pros:

1. Easy to implement.
2. Flexibility with system change, use of standardized receiver and Transmitter.

3. security, you can add excellent encryption on transmission.
4. Cheaper than analog in specific cases.
5. You can save your data and retrieve when needed.

Cons:

1. Not wide bandwidth.
2. Ambient weather Dependencies are high.
3. You couldn't move advance chip technology as software is again related.
4. Low life span as more Dependencies on outer source.
5. Sampling error is most common on many cases.

2. a) What is carrier signal? Describe the types of digital to analog signal conversion. 5

Ans:

Carrier signal: The carrier signal is the high frequency signal which carries the information through space as an electromagnetic wave.

Digital-to-analog conversion is a process by which digital signals are converted to analog signals. For example, a modem converts computer digital data to analog audio-frequency signals that can be transmitted over telephone lines.

1. Summing Amplifier

Since digital to analog conversion is simply a weighted sum of the binary input, a circuit called a summing amplifier is used. This is basically an op-amp amplifier with multiple resistors connected to one input. The junction where the resistors meet is called the summing junction or the virtual ground. The binary input goes into the resistors and the analog output is obtained on the output of the op-amp.

2. R-2R Ladder

This is the simplest type of DAC and needs only two resistor values arranged in a ladder. You can think of this as a somewhat complex voltage divider, though the math is quite complex.

The binary input goes into the 2R resistors and the output is obtained at the bottom of the ladder.

3. PWM DAC

This is the type of DAC that most of us have used without even knowing it.The popular Arduino microcontroller has the capability to output analog signals using a PWM signal. On the outset the PWM signal looks like a binary waveform with only high and low peaks with a variable duty cycle.

b) Write some various functions of physical layer. 4

Ans:

Following are the various functions performed by the Physical layer of the OSI model.

1. **Representation of Bits:** Data in this layer consists of stream of bits. The bits must be encoded into signals for transmission. It defines the type of encoding i.e. how 0's and 1's are changed to signal.
2. **Data Rate:** This layer defines the rate of transmission which is the number of bits per second.
3. **Synchronization:** It deals with the synchronization of the transmitter and receiver. The sender and receiver are synchronized at bit level.
4. **Interface:** The physical layer defines the transmission interface between devices and transmission medium.

c) What are the different causes of transmission impairment? 5

Ans:

In communication system, analog signals travel through transmission media, which tends to deteriorate the quality of analog signal. This imperfection causes signal impairment. This means that received signal is not same as the signal that was send.

Causes of impairment –

1. Attenuation

2. Distortion

3. Noise

- Attenuation It means loss of energy. The strength of signal decreases with increasing distance which causes loss of energy in overcoming resistance of medium. This is also known as attenuated signal. Amplifiers are used to amplify the attenuated signal which gives the original signal back.
- Distortion It means change in the shape of signal. This is generally seen in composite signals with different frequencies. Each frequency component has its own propagation speed travelling through a medium. Therefore, they have different phases at receiver end from what they had at senders end.
- Noise The random or unwanted signal that mixes up with the original signal is called noise. There are several types of noise such as induced noise, crosstalk noise, thermal noise and impulse noise which may corrupt the signal.

3. a) Define CDMA. Describe analog to analog conversion with figure. 7

Ans:

CDMA: CDMA is stands for Code division multiple access is a digital cellular network standard that utilizes spread-spectrum technology. This technology does not constrict bandwidth's digital signals or frequencies but spreads it over a fully-available spectrum or across multiple channels via division.

Analog-to-analog conversion can be accomplished in three ways:

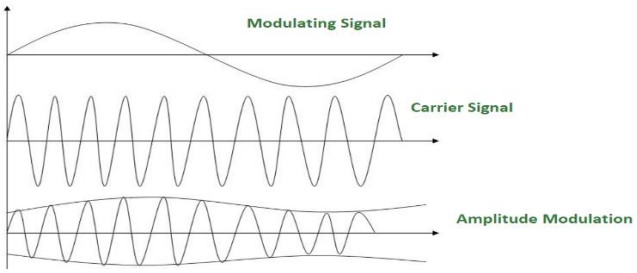
1.Amplitude Modulation (AM)

2.Frequency Modulation (FM)

3.Phase Modulation (PM)

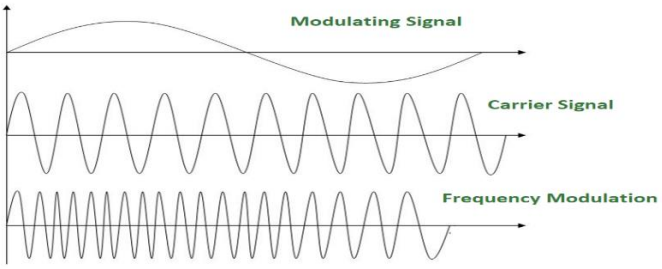
1. Amplitude Modulation:

In AM transmission, the carrier signal is modulated so that its amplitude varies with the changing amplitudes of the modulating signal. The frequency and phase of the carrier remain the same. Only the amplitude changes to follow variations in the information. The following figure shows how this concept works. The modulating signal is the envelope of the carrier.



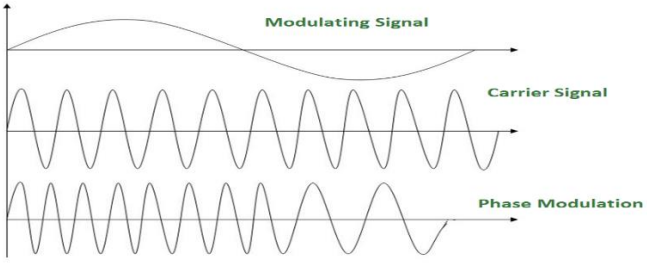
2. Frequency Modulation

In FM transmission, the frequency of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal. The peak amplitude and phase of the carrier signal remain constant, but as the amplitude of the information signal changes, the frequency of the carrier changes correspondingly.



3. Phase Modulation:

In PM transmission, the phase of the carrier signal is modulated to follow the changing voltage level (amplitude) of the modulating signal. The peak amplitude and frequency of the carrier signal remain constant, but as the amplitude of the information signal changes, the phase of the carrier changes correspondingly. It is proved mathematically that PM is the same as FM with one difference.



b) Difference between piconet and scatternet. 4

Ans:

Piconet	Scatternet
1. Formed by different networks linked together with the Bluetooth technology.	1. Formed by combining two or more piconets.
2. Has the ability serve up to 7-8 devices.	2. Can serve more than 8 devices.
3. Smaller area is covered.	3. Larger area is covered.
4. Allows less efficient use of channel bandwidth.	4. More efficient use of channel bandwidth.

c) What is NAT? briefly explain. 3

Ans:

NAT: To access the Internet, one public IP address is needed, but we can use a private IP address in our private network. The idea of NAT is to allow multiple devices to access the Internet through a single public address. To achieve this, the translation of private IP address to a public IP address is required. Network Address Translation (NAT) is a process in which one or more local IP address is translated into one or more Global IP address and vice versa in order to provide Internet access to the local hosts. The most common form of network translation involves a large private network using addresses in a private range (10.0.0.0 to 10.255.255.255, 172.16.0.0 to 172.31.255.255, or 192.168.0 0 to 192.168.255.255).

4. a) What is error correction? Write the types of error correction and briefly explain. 5

Ans:

Error Correction: Error Correction codes are used to detect and correct the errors when data is transmitted from the sender to the receiver.

In the digital world, error correction can be done in two ways:

1.Backward Error Correction: When the receiver detects an error in the data received, it requests back the sender to retransmit the data unit.

2.Forward Error Correction: When the receiver detects some error in the data received, it executes error-correcting code, which helps it to auto-recover and to correct some kinds of errors.

The first one, Backward Error Correction, is simple and can only be efficiently used where retransmitting is not expensive. For example, fiber optics. But in case of wireless transmission retransmitting may cost too much. In the latter case, Forward Error Correction is used.

b) What is Hamming code? Mention the algorithm of Hamming code. 5

Ans:

Hamming code :A hamming code is a linear code for error detection that can detect up to two simultaneous bit errors and is capable of correcting single-bit errors. Reliable communication is assured if the hamming distance between the transmitter and receiver is less than or equal to one.

Algorithm of Hamming Code

1. An information of 'd' bits are added to the redundant bits 'r' to form d+r.

2. The location of each of the (d+r) digits is assigned a decimal value.

3. The 'r' bits are placed in the positions 1,2,.....2^{k-1}.

4. At the receiving end, the parity bits are recalculated. The decimal value of the parity bits determines the position of an error.

c) What is roaming? Write a short note about GSM band. 4

Ans:

Roaming: Roaming refers to a wireless network service extension in an area that differs from the registered home network location. Roaming enables a mobile device to access the Internet and other mobile services when out of its normal coverage area. It also gives a mobile device the ability to move from one access point to another.

GSM Band: GSM stands for Global System for Mobile communications is an open, digital cellular technology used for transmitting mobile voice and data services. GSM differs from first generation wireless systems in that it uses digital technology and Time Division Multiple Access (TDMA) transmission methods. GSM is a circuit-switched system that divides each 200kHz channel into eight 25kHz time-slots. GSM operates in the 900MHz and 1.8GHz bands in Europe and the 1.9GHz and 850MHz bands in the US. The 850MHz band is also used for GSM and 3GSM in Australia, Canada and many South American countries. GSM supports data transfer speeds of up to 9.6 kilobit/s, allowing the transmission of basic data services such as SMS.

5. a) Discuss different types of errors and explain them. 5

Ans:

There are many reasons such as noise, cross-talk etc., which may help data to get corrupted during transmission. The upper layers work on some generalized view of network architecture and are not aware of actual hardware data processing.Hence, the upper layers expect error-free transmission between the systems. Most of the applications would not function expectedly if they receive erroneous data. Applications such as voice and video may not be that affected and with some errors they may still function well.

There may be three types of errors:

- **Single bit error**

In a frame, there is only one bit, anywhere though, which is corrupt.

- **Multiple bits error**

Frame is received with more than one bits in corrupted state.

- **Burst error**

Frame contains more than1 consecutive bits corrupted.

b) Explain the mechanism of checksum calculations. 6

Ans:

Step-01:

At sender side,

1.If m bit checksum is used, the data unit to be transmitted is divided into segments of m bits.

2.All the m bit segments are added.

3.The result of the sum is then complemented using 1's complement arithmetic.

4.The value so obtained is called as checksum**.**

Step-02:

1.The data along with the checksum value is transmitted to the receiver.

Step-03:

At receiver side,

1.If m bit checksum is being used, the received data unit is divided into segments of m bits.

2.All the m bit segments are added along with the checksum value.

3.The value so obtained is complemented and the result is checked.

Then, following two cases are possible-

Case-01: Result = 0

If the result is zero,

1.Receiver assumes that no error occurred in the data during the transmission.

2.Receiver accepts the data.

Case-02: Result ≠ 0

If the result is non-zero,

1.Receiver assumes that error occurred in the data during the transmission.

2.Receiver discards the data and asks the sender for retransmission.

c) What are the purposes of twisting in twisted pair cable? 3

Ans:

Twisted pair cables are of two types

1.UTP (Unshielded Twisted Pair)

2.STP (Shielded Twisted Pair)

The main reason for twisting in a twisted pair cable (particularly where two conductors exist together) it to cancel out any electromagnetic interference (EMI) that may be given out by external sources. These external sources could include crosstalk from other nearby pairs of cables or electromagnetic radiation given out by pairs of twisted cables that are not shielded . This method was created by Alexander Graham Bell.

6. a) What is framing? What kind of problems we face in framing? 4

Ans:

framing: Frames are the units of digital transmission particularly in computer networks and telecommunications. Frames are comparable to the packets of energy called photons in case of light energy. Frame is continuously used in Time Division Multiplexing process.

Problems in Framing –

- **Detecting start of the frame:** When a frame is transmitted, every station must be able to detect it. Station detect frames by looking out for special sequence of bits that marks the beginning of the frame i.e. SFD .
- **How do station detect a frame:** Every station listen to link for SFD pattern through a sequential circuit. If SFD is detected, sequential circuit alerts station. Station checks destination address to accept or reject frame.
- **Detecting end of frame:** When to stop reading the frame.

b) What is error correction. Explain about the error detection. 5

Ans:

Error Correction: Error Correction codes are used to detect and correct the errors when data is transmitted from the sender to the receiver.

Error Correction can be handled in two ways:

1.Backward error correction: Once the error is discovered, the receiver requests the sender to retransmit the entire data unit.

2.Forward error correction: In this case, the receiver uses the error-correcting code which automatically corrects the errors.

A single additional bit can detect the error, but cannot correct it.

For correcting the errors, one has to know the exact position of the error. For example, If we want to calculate a single-bit error, the error correction code will determine which one of seven bits is in error. To achieve this, we have to add some additional redundant bits.

Suppose r is the number of redundant bits and d is the total number of the data bits. The number of redundant bits r can be calculated by using the formula:

$2^r >= d+r+1$

The value of r is calculated by using the above formula. For example, if the value of d is 4, then the possible smallest value that satisfies the above relation would be 3.

c) Write the difference between ESS and BSS. 5

Ans:

ESS	BSS
1. Extended Service Set (ESS)	1. Basic Service Set (BSS)
2. ESS has 2 or more access point and Support mobility between AP's by using mobile IP	2. BSS has only one access point to connect wireless node, so not Support mobility
3. BSS s are connected through distribution system, which is usually a wired LAN	3. With AP is called an “infrastructure network”
4. It allows for wider area of coverage	4. Area covered by single AP is limited
5. More users than the Basic Service Set (BSS	5. BSS, is the smallest building block of a WLAN

7. a) What is circuit switching? Write the advantages and disadvantages of Circuit Switching. 5

Ans**:**

Circuit switching: Circuit switching is a connection-oriented network switching technique. Here, a dedicated route is established between the source and the destination and the entire message is transferred through it.

Advantages

1.It is suitable for long continuous transmission, since a continuous transmission route is established, that remains throughout the conversation.

2.The dedicated path ensures a steady data rate of communication.

3.No intermediate delays are found once the circuit is established. So, they are suitable for real time communication of both voice and data transmission.

Disadvantages

1.Circuit switching establishes a dedicated connection between the end parties. This dedicated connection cannot be used for transmitting any other data, even if the data load is very low.

2.Bandwidth requirement is high even in cases of low data volume.

3.There is underutilization of system resources. Once resources are allocated to a particular connection, they cannot be used for other connections.

4.Time required to establish connection may be high.

b) Explain packet switching and message switching briefly. 4

Ans:

Packet switching: Packet switching is a method of transferring the data to a network in form of packets. In order to transfer the file fast and efficient manner over the network and minimize the transmission latency, the data is broken into small pieces of variable length, called Packet. At the destination, all these small-parts has to be reassembled, belonging to the same file. A packet composes of payload and various control information. No pre-setup or reservation of resources is needed. Packet switching is a connectionless network switching technique. Here, the message is divided and grouped into a number of units called packets that are individually routed from the source to the destination. There is no need to establish a dedicated circuit for communication.

Message switching: Message switching was a technique developed as an alternate to circuit switching, before packet switching was introduced. In message switching, end users communicate by sending and receiving *messages* that included the entire data to be shared. Messages are the smallest individual unit. Also, the sender and receiver are not directly connected. There are a number of intermediate nodes transfer data and ensure that the message reaches its destination. Message switched data networks are hence called hop-by-hop systems.

c) Write some advantages of optical fiber over twisted pair cable. 5

Ans:

Fiber optic cable, twisted pair cable and coaxial cable are three major types of network cables used in communication systems. Each of them is different and suitable for different applications. Some advantages of optical fiber over twisted pair cable are given below

1. Greater Bandwidth:

Copper cables were originally designed for voice transmission and have a limited bandwidth. Fiber optic cables provide more bandwidth for carrying more data than copper cables of the same diameter.

2. Faster Speeds:

Fiber optic cables have a core that carries light to transmit data. This allows fiber optic cables to carry signals at speeds that are only about 31 percent slower than the speed of light—faster than Cat5 or Cat6 copper cables. There is also less signal degradation with fiber cables.

3. Longer Distances:

Fiber optic cables can carry signals much farther than the typical 328-foot limitation for copper cables. For example, some 10 Gbps single mode fiber cables can carry signals almost 25 miles. The actual distance depends on the type of cable, the wavelength and the network.

4. Better Reliability:

Fiber is immune to temperature changes, severe weather and moisture, all of which can hamper the connectivity of copper cable. Plus, fiber does not carry electric current, so it's not bothered by electromagnetic interference (EMI) that can interrupt data transmission. It also does not present a fire hazard like old or worn copper cables can.

8. a) Explain three basic multiplexing technique. 5

Ans:

Multiplexing techniques are mainly used in communication, and these are classified into three types. The 3 types of multiplexing techniques include the following.

1.Frequency Division Multiplexing (FDM)
2.Wavelength Division Multiplexing (WDM)
3.Time Division Multiplexing (TDM)

1. **Frequency Division Multiplexing**: The FDM is used in telephone companies in the 20th century in long-distance connections for multiplexing number of voice signals using a system like a coaxial cable. For small distances, low-cost cables were utilized for different systems such as bell systems, K-and N-carrier, however, they don't let huge bandwidths. This is analog multiplexing used to unite analog signals. This type of multiplexing is useful when the link's bandwidth is better than the United bandwidth of the transmitted signals.
2. **Wavelength Division Multiplexing**: In fiber communications**,** the WDM (Wavelength Division Multiplexing) is one type of technology. This is the most useful concept in high-

capacity communication systems. At the end of the transmitter section, the multiplexer is used to combine the signals as well as at the end of receiver section, de-multiplexer for dividing the signals separately. The main function of WDM at the multiplexer is for uniting various light sources into an only light source, and this light can be changed into numerous light sources at the de-multiplexer.

3. **Time Division Multiplexing**: The Time division multiplexing (or) TDM is one kind of method for transmitting a signal over a channel of particular communication with separating the time edge into slots. Like single slot is used for each message signal. TDM is mainly useful for analog and digital signals, in which several channels with low speed are multiplexed into high-speed channels used for transmission. Depending on the time, every low-speed channel will be assigned to an exact position, wherever it works in the mode of synchronized.

b) What is the difference between switch and hub? 5

Ans:

Switch	Hub
1. A network switch is a computer networking device that is used to connect many devices together on a computer network. A switch is considered more advanced than a hub because a switch will on send msg to device that needs or request it.	1. An electronic device that connects many network device together so that devices can exchange data.
2. It performs broadcast, then the unicast and multicast as needed.	2. Hubs perform frame flooding that can be unicast, multicast, or broadcast.
3. Varied ports have separate collision domains.	3. Just a singular domain of collision is present in a hub.
4. A switch operates on the data link layer.	4. A hub operates on the physical layer.
5. Allow connecting multiple devices and ports.	5. To connect a network of personal computers should be joined through a central hub.
6. No collisions occur in a full-duplex switch.	6. Collisions occur mostly in setups using hubs.

c) What is guided and unguided transmission medium? Write a short notes about Radio waves. 4

Ans:

Guided medium, which are those that provide a conduit from one device to another, include twisted pair cable, coaxial cable, and fiber-optic cable. And unguided medium transport electromagnetic waves without using a physical conductor. This type of communication is often referred to as wireless communication.

Electromagnetic waves ranging in frequencies between 3 KHz and 1 GHz are normally called radio waves.

Radio waves are omnidirectional. When an antenna transmits radio waves, they are propagated in all directions. This means that the sending and receiving antennas do not have to be aligned. A sending antenna send waves that can be received by any receiving antenna. The omnidirectional property has disadvantage, too. The radio waves transmitted by one antenna are susceptible to interference by another antenna that may send signal suing the same frequency or band.